SDMS DocID 2001316

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September 19, 2003

RECEIVED
SEP 23 2003
PRP INV/INFO SECTION

Ms. Carolyn Winter Prisk
(3HS11) U. S. Environmental Protection Agency
Region 3
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Re: Lower Darby Creek Area Superfund Site – Clearview Landfill, Folcroft Landfill and Folcroft Landfill Annex

Dear Ms. Prisk:

Please be advised that the principal of our firm, Michael F. X. Gillin is the Solicitor for the Delaware County Solid Waste Authority who has been identified as a potentially responsible party in the above-captioned Superfund Site. Delaware County Solid Waste Authority is an active member of the Joint Defense Steering Committee directed by liaison counsel, Michael Dillon of Morgan, Lewis & Bockius.

It has come to our attention during the recent meeting between your colleague, Brian Nishitani and yourself along with the Third Party Practice Committee, of which Delaware County Solid Waste Authority is a member, that the Authority's original 104(e) response was missing from the documents which you provided Michael Dillon and the Third Party Practice Committee. You had indicated in your comments regarding the missing 104(e) response that you had intended to follow-up with the Authority. It appears that such follow-up action will not be needed.

I have enclosed a copy of our original response to the 104(e) Request for Submissions which had been addressed to the Authority regarding the above-captioned Superfund Site. Our response dated December 3, 2001 was hand-delivered to you by Michael F. X. Gillin, Solicitor for the Delaware County Solid Waste Authority. It appears that such response must have been inadvertently misplaced in your records.

Please accept this response for your files. By copy of this letter, I am also sending a copy to Michael Dillon, Esquire as liaison counsel for the Steering Committee of the PRP Group, so that there will be no need for you to duplicate such effort.

This should resolve your need for any follow-up action. We ask that you correct the status of the Delaware County Solid Waste Authority as being responsive to your 104(e) Request for Submission. If you need any further information, please do not hesitate to contact us. Otherwise, we look forward to maintainig our cooperative relationship with the EPA through the Steering Committee of the PRP's Group for this site.

Very truly yours,

MICHAEL F. X. GILLIN & ASSOCIATES

BY: Aileen M. Campbell

Aileen M. Campbell

AMC:cd
Enclosure
cc: Michael Dillon, Esquire

Delaware County Solid Waste Authority

Rose Tree Park - Hunt Club
1521 North Providence Road
Media, PA 19063
(610) 892-9627-9628
Fax: (610) 892-9622

Joseph W. Vasturia, P.E.
Chief Executive Officer

December 3, 2001

Ms. Carolyn Winter Prisk
(3HS11) U. S. Environmental Protection Agency
Region 3
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Re: Lower Darby Creek Area Superfund Site – Clearview Landfill, Folcroft Landfill and Folcroft Landfill Annex

Dear Ms. Prisk:

In response to your questions regarding the above matter, I offer the following:

1.) The mailing address for Delaware County Solid Waste Authority is as follows: Rose Tree Park/Hunt Club, 1521 N. Providence Road, Media, PA 19063; phone number is (610)-892-9620.

a.) The Delaware County Incinerator Authority was incorporated in the State of Pennsylvania on April 22, 1954.

b.) April 22, 1954; Pennsylvania

c.) None

Further response to question #1:

The Delaware County Incinerator Authority changed its name to the Delaware County Solid Waste Authority on March 14, 1985 in the State of Pennsylvania.

2.) The Delaware County Solid Waste Authority is responsible for receiving and disposal of municipal solid waste generated in Delaware County. Since 1958 through 1976, the Delaware County Incinerator Authority was responsible for the receiving and disposal of municipal solid waste collected in Delaware County. Since 1985, Delaware County Solid Waste Authority has acquired a municipal landfill located in Earl Township, Berks County, known as the Rolling Hills Landfill. Delaware County Solid Waste Authority continues to receive all residential municipal solid waste collected in Delaware County and some commercial municipal solid waste collected in Delaware County.

3.) Unknown at this time

4.) Unknown at this time. This writer does know that the incinerator located adjacent to the Folcroft Landfill operated during the early 1970's and was subsequently closed in mid-1970. It presently houses the emergency service training facility for the County of Delaware. The County was responsible for the disposal of all residential municipal solid waste generated in the County, some of which was incinerated at the Folcroft Incinerator. The method of disposal and the location at which the ash or other waste was disposed of is unknown at this time. Information concerning this site and this incinerator are attempting to be gathered for a review of the archived records.

5.) See attached Delaware County Solid Waste Master Plan.

6.) These documents are attempting to be located in the County Archives which will be produced if available.

7.) This information is being investigated to determine if any records exist. The County has historically not collected hazardous substances. The County has only been required under ordinance to dispose of residential municipal solid waste generated within Delaware County.

8.) The County was responsible for the disposal of all residential municipal solid waste generated within the County. Originally, it disposed of this waste by incineration at three incinerator plants located within the County. After the close of the incinerators in the mid-seventies, this municipal solid waste was transported to various landfills in Pennsylvania and New Jersey. Since 1985, all municipal solid waste has been transported to its landfill located in Berks County either as raw msw or as incinerated ash from the American Ref-Fuel trash to steam plant located in the City of Chester.

9.) This question is being investigated and attempts to find documentation on this is being reviewed. I am enclosing copies of information I have received regarding Clearview Landfill which indicates that County of Delaware and the Delaware County Solid Waste Authority has never used the Clearview Landfill for disposable activities.

10.) Enclosed is the list of all of the individuals who were Board members of the Delaware County Incinerator Authority when it was created in 1954. Additional information is being investigated at the present time. By way of further answer, the Delaware County Incinerator Authority and the Delaware County Solid Waste Authority has never utilized

Clearview Landfill for any disposable activities.

11.) The Delaware County Incinerator Authority and the Delaware County Solid Waste Authority have never utilized Clearview Landfill for any disposable materials. An investigation is being conducted to determine whether or not the Delaware County Incinerator Authority used the Folcroft or Folcroft Annex.

12.) As of this writing, the Delaware County Incinerator Authority and the Delaware County Solid Waste Authority has never disposed of any substance at the Clearview Landfill. An Investigation is being conducted to determine whether or not the Delaware County Incinerator and Delaware County Solid Waste Authority has ever utilized Folcroft or Folcroft Annex as a disposal.

13.) Response to this question is still being investigated by the Delaware County Solid Waste Authority. There are no known individuals that are presently alive to substantiate those persons responsible for the responses to question 13.

14.) Response to this question is still being investigated.

15.) Attached is information regarding the Clearview Landfill which indicates that the Delaware County Solid Waste Authority never utilized this landfill for any disposable activities. Further investigation is being conducted to determine whether or not any records exist as far as the Folcroft and Folcroft Annex Landfills are concerned.

16.)

a.) Michael F.X. Gillin, Solicitor, Delaware County Solid Waste Authority; 230 N. Monroe Street, Media, PA 19063, (610)-565-2211

b.) Michael F.X. Gillin, Solicitor, Delaware County Solid Waste Authority, 230 N. Monroe Street, Media, PA 19063, (610)-565-2211

17.) The archives are still being searched for documentation as to the questions above. Upon investigation and review of all documentation in the archives, a further submission will be forthcoming.

If there are any further questions that you might have regarding these responses, please contact me.

Very truly yours,

Michael F.X. Gillin, Solicitor

MFXG/dmz-e
cc: Joseph Vasturia, CEO
Francis Catania, County Solicitor

FILE COPY

MARKS, KENT & O'NEILL, P.C.
BY: JOHN F. KENT, ESQUIRE
IDENTIFICATION NO. 26767
SUITE 500, TWO MELLON BANK CENTER
PHILADELPHIA, PA 19102-2399
(215) 564-6688

ATTORNEY FOR DEFENDANT, DELAWARE COUNTY

DAVID J. SMALLS and VIRGINIA SMALLS, h/w	:	PHILADELPHIA COUNTY COURT OF COMMON PLEAS
v.	:	APRIL TERM, 1985
DELAWARE COUNTY, et al.	:	No. 633

AFFIDAVIT IN SUPPORT OF
MOTION FOR SUMMARY JUDGMENT

NOW COMES, the undersigned, Matthew J. Hayes, who being of full age and duly sworn according to law upon his oath deposes and says.

1. I, Matthew J. Hayes, am the Executive Director of the County of Delaware.

2. I began working for the County of Delaware in September of 1977 in the position of Budget Director.

3. On June 26, 1979, in addition to being the Budget Director, I assumed the responsibilities of Executive Director of Delaware County.

4. Since March 15, 1982, to the present, I have maintained only those responsibilities which accompany the position of Executive Director.

5. I am familiar with the history of Delaware County's Solid Waste operations, and can attest to the fact that the County of Delaware has been handling its own solid waste through its own incinerator sites since at least 1958.

6. The existence of such incinerator sites can be substantiated by referring to the Controllers' Reports for any relevant year dating back to 1958.

7. The County of Delaware has maintained their own Solid Waste Disposal facilities since 1958, as such, the County had used other landfills for incinerator ash (residue); however, we have never used Clearview Landfill for trash or residue disposal.

Matthew J. Hayes

MATTHEW J. HAYES

LIST OF MEMBERS OF
BOARD OF DELAWARE COUNTY
INCINERATOR AUTHORITY 1954

Norman K. Seiple, Chairman
John A. Carr, Secretary
Norman G. Young, Member
Perry Martin, Member
Clarence T. Pepper, Member
James A. Cochrane, Solicitor

REPORT

ON

The Methods

of

Collection and Disposal

of

Refuse

IN

DELAWARE COUNTY, PENNA.

DELAWARE COUNTY INCINERATOR AUTHORITY

MAY, 1956

By

Damon & Foster

CONSULTING ENGINEERS

Sharon Hill, Pa.

Associate Engineering Consultants

Cotton, Pierce, Streander, Inc.

New York City, N. Y.

544

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APPENDICES

ADDENDUM

Page 37 - Para. 3.5 - substitute Fig. No. 4 for Fig. 1

Page 110- Para. 6.3.1.1. - substitute Fig. No. 5 for Fig. 3

Page 114- Para. 6.3.2.1. - substitute Fig. No. 6 for Fig. 4

Page 118- Para. 6.3.3.1. - substitute Fig. No. 7 for Fig. 5

Page 136- Para. 7.1.4. - refer to Fig. 8

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SUMMARY OF REPORT

AUTHORIZATION FOR AND CONTENTS OF REPORT

The results of the preliminary surveys, investigations, recommendations and estimated costs of refuse disposal in Delaware County, the preparation of which was authorized by the articles of agreement for engineering services with the Authority, are given in the details of the report and are contained in the following chapters of this report:

Chapter 1 - Refuse Materials
Chapter 2 - Present Refuse Collection and Disposal Practices
Chapter 3 - Population Studies
Chapter 4 - Quantities of Refuse
Chapter 5 - Methods of Refuse Disposal
Chapter 6 - Studies of Incineration
Chapter 7 - Studies of Landfill
Chapter 8 - Recommended Methods of Disposal
Chapter 9 - Estimated Costs
Chapter 10- Proposed Collection Methods
Chapter 11- Operation of Incineration Authority

This report, of which the following is a summary, is intended to submit to the Delaware County Incinerator Authority pertinent data upon which can be based a plan for refuse disposal in Delaware County.

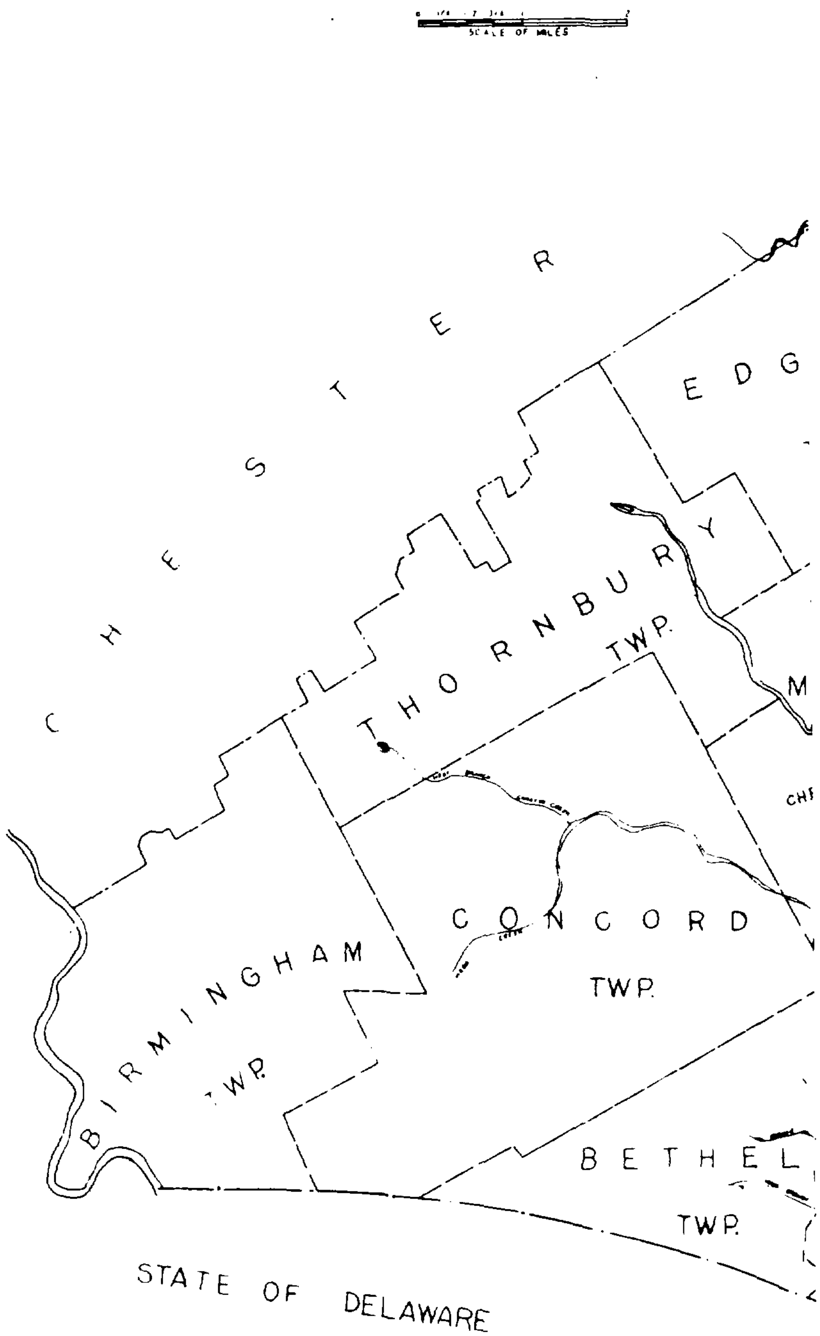
PRESENT PRACTICE OF REFUSE DISPOSAL

Present practices are largely a continuation from earlier days when garbage was hauled to piggeries and rubbish to dumps.

Recent laws have been enacted which prohibit the feeding of raw garbage to pigs, and, where the piggeries are still in operation, the garbage must be cooked in accordance with the requirements of the State Department of Health. Only a few piggeries are now in operation in Delaware County and most of the

DELAWARE COUNTY INCINERATOR
DELAWARE COUNTY, PENN.

DAMON & FOSTER
CONSULTING ENGINEERS
SHARON HILL, PA.
COTTON, PIERCE, STREANDER, INC.
ASSOCIATE ENGINEERS
NEW YORK CITY, N.Y.
MARCH 1958



garbage is hauled outside the County thus involving expensive haulings.

Dispositious of rubbish has generally been made at dumps created by abandoned quarries, or at low areas along the Creeks and Delaware River. These areas are being repidly filled and no new areas, within reasonable hauling distances, are to be found largely due to the expansion of population involving dwellings and related business activities. A portion of the rubbish produced in Delaware County could probably be hauled to Philadelphia for disposal by burning, but, that City has announced that burning rubbish must cease as soon as its incineration capacity is reached.

NEED FOR REFUSE DISPOSAL FACILITIES

Some thirty five years ago the county recognized the need for the abatement of sewage pollution in its creeks and rivers and as a result set up three sewer authorities to finance the construction and operation of sewage collecting and treatment facilities for the major part of the county. These plants, together with others constructed previous to the formation of the authorities are located as shown in Figure No. 1.

Today, the county is facing a similar problem in disposing of the refuse emanating therein. An indication of the seriousness of the problem is that some 200,000 tons of refuse, consisting of garbage, rubbish, etc., are presently collected each year and that this will increase to about 300,000 tons per year by 1980.

ENABLING ACT

Recognizing the necessity for action on the part of various subdivisions within the State, in respect to sanitary disposal of refuse, the State of Pennsylvania enacted Act No. 164 (P.L.382).

On April 22nd, 1954, the Delaware County Commissioners established the Delaware County Incinerator Authority with powers to act in respect to sanitary methods of refuse disposal by incineration or otherwise. This body is now constituted with the following members:

Norman K. Seiple, Chairman
John A. Carr, Secretary
Norman G. Young, Member
Clarence T. Pepper, Member
Perry Martin, Member
James A. Cochrane, Solicitor

METHODS OF REFUSE DISPOSAL

In addition to the present practices mentioned, namely, garbage to piggeries and rubbish to dumps, other methods for disposal of refuse may be employed as follows:

1. Composting
2. Household Disposal Units (Garbage Grinders)
3. Central Garbage Grinding Stations
4. Sanitary Land Fill
5. Incineration

COMPOSTING

The practice of composting garbage and some elements of rubbish which contain organic matter, has been conducted as a limited scale in Europe, particularly where acreage was extremely scarce. Several large scale experimental plants have been built in this country, but, wherever the process has been considered for municipal operations the costs have been too high, particularly as other means must be used for the disposal of rubbish. Further, for satisfactory results it must be scientifically processed, for the product to be used as a fertilizer. The practice of composting has, therefore, not gained favor in this country.

HOUSEHOLD DISPOSAL UNITS

Household disposal units, sometimes known as kitchen grinders, are attracting increasing attention and use. The unit is fundamentally a grinder and is installed in association with the kitchen sink, disposing of the waste in the sanitary sewer. Where the sewers and treatment plants are designed for the purpose there can be no objection to the practice. An added load is imposed upon the sewer to the extent of about 3 percent increase in flow, an increase of about 50 percent in suspended solids and from 30 to 50 percent in the BOD of the sewage delivered to the treatment plant. This would probably require additional facilities at the sewage treatment plants in the County. It is understood that the Sewer Authorities established in Delaware County now object to kitchen grinders because of the added treatment facilities required. While use of household grinders may eventually be wide spread, their use would only dispose of the garbage. Other facilities would have to be provided for disposing of the rubbish, so, the use of garbage grinders would not solve the present refuse disposal problem.

SANITARY LANDFILL

From the viewpoint of economy and where acreage is available, the practice of sanitary landfill is widely followed. The process consists of digging a trench 8 feet or more in width and up to 10 feet in depth, depending on the available acreage and the term of years in contemplation. A tractor type machine is used to compact the garbage and rubbish as dumped by the collection trucks. After thorough compaction the material is covered at the end of each day's operation and a depth of 2 feet is reserved for final coverage. The cover materials are usually those which have been excavated in creating the trench.

The areas thus treated can be made available for park or recreational purposes at a reasonably early date, and the process can be started promptly after acquisition of the land. In view of the pressing needs for means of refuse disposal in Delaware County, consideration of sanitary landfill practices has been taken into account.

The studies made indicate that some 2-1/2 square miles of area would be required for county wide disposal of refuse by the year 1980. Most of the available area consists of swamp lands in Tinicum Township and the adjoining swamp lands. Landfill operations in such areas would be quite expensive due to the necessity of having to construct dikes and their operating facilities, and in having to haul the cover materials from points remote to the site.

As set forth in Chapter No. 7, Studies of Landfill, it is indicated the eventual cost by 1980 for county wide disposal would be about as follows:

Capital Cost	$4,600,000.00
Annual Operating and fixed costs	955,000.00
Average cost per ton of refuse	3.00

Careful consideration of all facts pertaining to the landfill method of refuse disposal indicates it would not be practical for county wide use. Until the incinerator plants are constructed it could be used on a temporary basis.

INCINERATION

The process of incineration has been developed through many years to the point that it is entirely inoffensive from an aesthetic viewpoint, and it is particularly adaptable to densely populated areas such as exist in the eastern and southern sections of the county, where some 90 percent of the population lies within about 55 percent of the county area. The estimated population in 1955 is 501,210 which places Delaware County and its problems in a class with such cities and areas as Pittsburgh, Pennsylvania, Atlanta, Georgia, Milwaukee, Wisconsin, Buffalo, New York, and others.

The standard basis for estimating incineration capacity is in tons per day of refuse to be consumed. Two municipalities of Delaware County, namely, Upper Darby Township and City of Chester, each having a sizeable population were selected to form a basis for computing the tonnage load in production of refuse in the county as a whole. Upper Darby Township, population in 1955, namely 91,280, has recently made a survey of refuse production which included all classes of activity and results in an average figure of 3.20 pounds per person per day. The City of Chester, population in 1955, 70,280, contracts for haulage of garbage and refuse separately. Contact with these haulers revealed that the average production of refuse amounted to 2.87 pounds per person per day. These are both on the basis of 300 collecting days per year. For a 365 day year the quantities would be 2.62 and 2.32

pounds per day respectively.

Combining the two areas results in a population of 161,560 or about 32 percent of the total in the county, and compensating for the difference in population results in a figure of about 3.00 pounds per person per day for 300 collecting days and 2.56 p ounds per capita per day for a 365 day year.

A careful consideration of all data collected and of comparisons of refuse quantities in other cities indicates that the per capita amounts of refuse to be disposed of in a 300 day collecting year would be about as follows:

Average daily	2.60 pounds per capita
Maximum month	3.00 pounds per capita
Maximum day	3.22 pounds per capita
Minimum month	2.20 pounds per capita
Minimum day	1.90 pounds per capita

Based on the foregoing the annual production of refuse would be about 800 pounds per capita.

As given in Chapter No. 6, Studies of Incineration, studies were made of the capital and annual operating costs of the three schemes, namely:

Scheme A - Two Incinerator Plants
Scheme B - Three Incinerator Plants
Scheme C - Four Incinerator Plants

The comparative costs of the three schemes are given therein to be as follows:

	Scheme A	Scheme B	Scheme C
Capital Costs	$6,100,000.	$7,000,000.	$8,000,000.
Annual Costs (1980)	846,000.	1,059,000.	1,172,000.
Costs per ton (1980)	$3.50	$4.30	$4.70

The foregoing do not include certain costs that would be common to all, such as the salaries of the Authority, business personnel, costs of water, etc.

The foregoing costs indicate that Scheme A, Two Incinerator Plants, would be the least costly. However, when hauling costs are considered, and the objection of having a large number of trucks concentrated at two sites, it is indicated that the three plant scheme would be the more desirable one to use.

RECOMMENDED METHODS OF DISPOSAL

Under Chapter No. 8, Recommended Methods of Disposal, there are given the recommendations for the disposal of the refuse. This consists of the construction of three incinerator plants to serve a present population of 481,370 of the county total of 501,210, and two landfill operations to serve a present population of about 20,000. The 1980 estimated population to be served by the two methods would be 638,000 and 65,000 respectively.

It is also stated in this chapter that the municipalities in the sparsely settled westerly and northwesterly parts of the county now have no interest in having the Authority dispose of their refuse. For this reason, and as landfill operations, only, are applicable to these areas, landfill operations by the Authority are not recommended at this time. Should realty development occur at a faster rate than now anticipated in these areas, the Authority could in the future either dispose of the refuse by landfill operations, or preferably have the refuse hauled to one of the incinerator plants.

ESTIMATED COST OF RECOMMENDED CONSTRUCTION

The estimated construction cost of the recommended three incinerator plants is $5,900,000. To this must be added the cost of facilities for temporary landfill operations at the three incinerator plant sites; the Authority personnel building; the purchase of land for two sites, together with the purchase of the present Haverford incinerator plant and its land; construction contingencies; engineering and legal costs and bond discount amounting to $1,490,000, giving a total cost of $7,390,000. This was taken as $7,400,000, as the capital cost of the proposed incinerator program of construction.

The costs of operation and maintenance of the three plants and the fixed charges of bond retirement and interest costs are estimated to be as follows:

Annual Costs	1955	1960	1970	1980
Operation Costs	$ 600,000.	$ 625,000.	$ 650,000.	$ 675,000.
Fixed charges	444,000.	444,000.	444,000.	444,000.
Totals	$1,044,000.	$1,069,000.	$1,094,000.	$1,119,000.
Avg.Tons incinerated	187,800	207,900.	236,700	249,000
Costs per Ton				
Operating Costs	$3.20	$3.01	$2.75	$2.71
Fixed charges	2.36	2.14	1.88	1.78
Totals	$5.56	$5.15	$4.63	$4.49

Probable average cost per ton $5.00

ANNUAL COST TO EACH MUNICIPALITY

In Chapter No. 9, Estimated Costs, there are given the estimated annual costs to each of the municipalities recommended for inclusion in the overall program of refuse disposal by incineration. Reference is made to this Chapter for these costs.

COLLECTION METHODS

The Authority should recognize the needs of having a uniform

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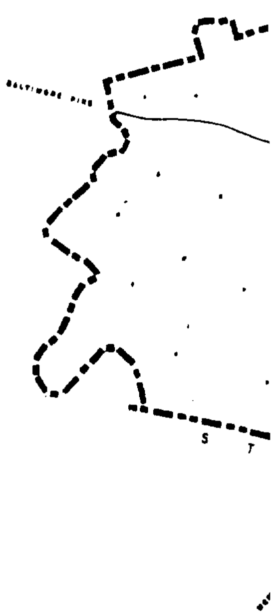


SOURCE
U. S. CENSUS 1960

DELAWARE COUNTY
M E D I A P E

practice set up for the collecting and delivery of the refuse to the three incinerator plants. The Authority's refuse disposal agreements with the municipalities should also be based on having all refuse delivered to the plants in enclosed or packer trucks. This should be done to eliminate nuisances generally created by the littering of streets with light refuse materials from open trucks nearby the sites of the plants.

POPULATION DISTRIBUTION

The distribution of population in the County, revised in accordance with 1955 estimates, is shown on Figure 2, for the respective municipalities.

CONCLUSIONS

The presentation of this report constitutes the first step in this important program for the elimination of open, burning, malodorous and vermin infected dumps. With the rapidly expanding population of the county, requiring the use of lands that soon may be nearby these dumps, it is essential that the succeeding steps be promptly undertaken to place this much needed program in operation. Steps should be taken to acquire the lands for the incinerator sites; the entering into of agreements with each of the various municipalities for the disposal of the refuse; the preparation of plans and specifications for the construction of the work and arrangements made for the advertising and sale of the bonds to finance the construction of the work.

The execution of the agreements with the municipalities for the disposal of their refuse is the next most important step to be taken as they will constitute the basis on which the revenue bonds will be sold.

CHAPTER I - REFUSE MATERIALS

1. DEFINITIONS OF REFUSE COLLECTION TERMS

As used in this report, the terms employed refer to refuse and its component materials and will have the meanings set forth in the following paragraphs. In all cases the meanings conform to the most wide-spread use of the term.

1.1 Waste

The work waste is used to refer to the useless, unused, unwanted, or discarded materials resulting from natural community activities. Wastes include solids, liquids, and gases. The gases are principally industrial fumes and smoke; the liquids consist mainly of sewage and the fluid part of industrial waste; the solids are classed as refuse. It is impossible, however, to make a hard and fast classification of municipal wastes or to state absolutely the kinds of materials that constitute that part called refuse. A part of the solid refuse materials produced in a community, particularly particles of garbage and rubbish, finds its way into sewers and is disposed of with the liquid sewage wastes. Conversely, some food wastes in a semi-liquid condition are accepted by private collectors of refuse as swill for hog feeding.

1.2 Refuse

The term refuse is used to refer to solid wastes. Its component materials can be classified in several different ways. In connection with some problems, its point of origin is important and from this standpoint it can be considered as made up of domestic institutional, commercial, industrial, or street refuse. For other problems the point of origin is not so important as the nature of the material itself, and classification might be made on the basis of organic or inorganic character, combustibility or noncombustibility, putrescibility or nonputrescibility. One of the most useful classifications, however, is based on the character of material and includes garbage, rubbish, ashes, street refuse, dead animals, abandoned automobiles, and industrial refuse, of which the first three classes are most important.

Ordinarily, the disposal of industrial refuse is not considered a municipal responsibility, although there is a discernible trend toward municipal collection of some kinds of trade refuse. The collection and disposal of street refuse is considered a street cleaning function, the responsibility for the removal of abandoned vehicles from the streets is usually assigned to the street cleaning bureau or the police department, and while the removal and disposal of dead animals is not infrequently one of the duties of a municipal refuse collection agency, it is often managed more as a special problem than as a routine activity. The bulk of the refuse collection agency's duties consists of the collection of garbage, rubbish and ashes.

1.3 Garbage

Garbage is the animal and vegetable waste resulting from the handling, preparation, cooking, and consumption of foods. It is composed largely of organic matter and its natural moisture conten

It does not include more than a minimum amount of free liquids. The term does not include, within its meaning, food-processing wastes from canneries, slaughter-houses, packing plants, or similar industries, nor large quantities of condemned food products. Garbage originates primarily in kitchens, stores, markets, restaurants, hotels, and other places where food is stored, cooked, or consumed.

Garbage decomposes rapidly, particularly in warm weather, and may soon produce disagreeable odors. When carelessly stored, it is a source of food for rats and other vermin, and serves as a breeding place for flies and other insects.

There is considerable commercial value in garbage as animal food or as a base for commercial animal feeds. It may also have some value for its grease content and as plant fertilizer.

The terms "swill," "slops," and "offal," which are frequently found in city ordinances to define garbage, are not properly synonymous with garbage. "Swill" and "slops" connote semi-liquid waste material consisting of garbage and free liquids. Municipalities ordinarily do not collect such material, but at times the hog raisers operating as private collectors haul it from restaurants, hotels, and institutions. The word "offal" has so many different meanings that its use has been avoided in the text discussions.

1.4 Ashes

The term ashes means the residue from the burning of wood, coal, coke, and other combustible material in homes, stores, institutions, and small industrial establishments for the purposes of heating, cooking, and disposing of waste combustible material. Cinders produced in steam generating plants are not included within the meaning of the term.

Ashes are usually composed of a mixture of fine powdery residue, cinders, clinkers, and small portions of unburned or partially burned fuel or other materials, although small pieces of metal, glass, and other noncombustible materials are usually found in it when it is presented for collection. The mixture is almost entirely inorganic and therefore is valuable for making fills on low land, even in or near built-up communities, and it is acceptable in some cases for maintaining unimproved city streets. Except for the dust that may be created, ashes are not objectionable from a nuisance or aesthetic standpoint.

The residue from household refuse incinerators and from yard rubbish burners is normally classed as ashes, as are also the remains from burning leaves and yard rubbish in open fires. However, when garbage is only partly consumed in inefficiently operated domestic incinerators, local authorities may sometimes require that the contents of incinerator pits be stored and collected as garbage.

1.5 Rubbish

Rubbish is all refuse not included in garbage and ashes. It consists of a great variety of both combustible and noncombustible waste materials from households, stores, and institutions. This waste will be defined more specifically under "combustible rubbish" and "noncombustible rubbish" but whenever the word rubbish is used alone it means a mixture of both combustible and noncombustible rubbish. "Trash" is considered to be synonymous with rubbish but the word will not be employed in these discussions.

1.6 Combustible Rubbish

Combustible rubbish comprises miscellaneous burnable materials. In general it is the organic component of rubbish, such as paper, rags, cartons, boxes, wood, excelsior, furniture, bedding, rubber, leather, tree branches, yard trimmings, and so on. Some municipalities use this term to mean only such designated burnable materials as they will accept at regular collections. In such cases certain materials are specifically included or excluded in their ordinance definitions.

Combustible rubbish, though organic, is not putrescible, and does not cause nuisance or offense even when stored on the premises for long periods. It has a high heat value and when dry burns freely without forced draft and without the necessity of adding other fuels. When collected separately, it is used to some extent as fuel for steam generation. Often it is collected with garbage to provide the necessary fuel to burn this refuse in an incinerator. The paper, rags, and cartons also have some salvage value, particularly when the market for these waste materials is good.

1.7 Noncombustible Rubbish

Noncombustible rubbish comprises miscellaneous refuse materials that are unburnable at ordinary incinerator temperatures (800°F. to 1800°F). For the most part, it is the inorganic component of rubish, such as tin cans, metals, mineral matter, glass, crockery, dust, metal furniture, and the like.

Noncombustible rubbish is very stable and causes no sanitary nuisance, although some of the metals undergo slow disintegration by oxidation. When carelessly stored or dumped, however, it is objectionable on aesthetic grounds.

There has been much discussion among sanitary engineers and public health officials as to the proper classification of tin cans that have been used as food containers and, when discarded, have particles of putrescible organic matter clinging to them. Because of this putrescible matter some argument can be advanced for including such cans with garbage, but it is now more or less generally accepted that under ordinary conditions the organic matter desiccates rather than putrifies. Therefore, as used herein, noncombustible rubbish includes tin food containers. In a warm, moist atmosphere, however, the food particles may serve as breeding places for flies and other insects and therefore the presence of tin cans in the rubbish may necessitate more frequent collection.

The metals, tin cans, bottles, and broken glass contained in noncombustible rubbish have considerable salvage value when prices are high.

1.8 Yard Rubbish

Yard rubbish consists of tree branches, twigs, grass and shrub clippings, weeds, leaves, and general yard and garden waste materials. When presented for collection it often contains a certain quantity of dirt. Yard rubbish is really a part of combustible rubbish rather than a main class by itself, but requires separate definition because municipalities frequently make different arrangements for its collection and disposal and because some exclude it entirely from their service.

A considerable part is green vegetation which, when kept moist or when stored in large masses, decomposes rather rapidly. It is not ordinarily objectionable, but under certain conditions may serve as a breeding place for insects. This green material can be burned in an incinerator, but will not normally sustain a fire alone. Dried vegetation, dead leaves, and plants do not cause any sanitary nuisance and ordinarily will burn readily in an open fire

1.9 Building Rubbish

Building rubbish is the waste material from construction, remodeling, and repair operations on houses, commercial buildings, and other structures. It comprises, among a great variety of rejected matter, excavated earth, stones, bricks, plaster, wallpaper, lumber, shingles, concrete, and waste parts occasioned by the installation or replacement of plumbing, heating systems, electrical work, and roofing.

A very small amount of this refuse material is usually accepted as the normal waste from households and stores, but for the most part it is not considered a part of municipal refuse. It is generally regarded as the industrial refuse of contractors and builders.

1.10 Industrial Refuse

Industrial refuse consists of the solid waste materials from factories, processing plants, or other manufacturing enterprises. The collection of such matter is rarely regarded as an obligation of the community or even as a governmental function, but rather as a part of the industrial process. Refuse of this class include putrescible garbage from food-processing plants and slaughterhouse condemned foods; building rubbish; cinders from power plants; and miscellaneous manufacturing refuse.

Because putrescible industrial refuse may cause serious nuisances and even endanger public health, its storage, hauling, and disposition are subject to municipal control.

1.11 Market Refuse

Market refuse is the garbage from wholesale and retail stores and markets, resulting from the handling, storage, and selling of food materials. It originates principally in poultry, fish, vegetable, and fruit markets, from the ordinary operations of preparing fresh produce for sale. It does not include condemned food or large quantities of spoiled material.

As market refuse is highly putrescible, the protection of the fresh food supply of the community makes frequent collection necessary, in many cases by the regular municipal collection agencies

1.12 Unit Weight of Garbage

The unit weight of garbage is subject to many vagaries which greatly influence the result toward one extreme or the other. First of all are the restrictions which may be placed upon the householder by existing sanitary ordinances and collection regulations. If the garbage is required to be drained and wrapped, the amount of retained moisture will naturally be decreased, which together with the added bulk of the paper wrapping will result in a lighter unit weight per cubic yard.

On the other hand, if householders habitually pack the materi into containers, or if the collectors subsequently compact the loa the unit weight tends to increase. Garbage in uncovered container or open collection vehicles is likely to become saturated beyond its original condition during rain, snow, and sleet storms, increasing the unit weight.

A typical illustration of the range in the weight of garbage per cubic yard is contained in the following table, which indicates a minimum of 798 pounds, and a maximum of 1,540, the median average being 926 pounds per cubic yard.

City	Tons Collected	Cubic Yards Collected	Pounds Per Cubic Yard
Cedar Rapids, Ia.	13,522	33,805	798
Altoona, Pa.	5,166	12,399	833
Los Angeles, Calif.	183,170	400,399	916
New London, Conn.	2,527	5,400	936
Elgin, Ill.	5,553	11,106	1,000
Dayton, Ohio	35,036	45,549	1,540

1.13 Unit Weight of Rubbish

As this class of refuse is composed of a great variety of both combustible and noncombustible materials, unit weights will vary widely, depending primarily on the collection practices of the various municipalities, as to the materials regularly picked up and those definitely excluded from collection. For example, dry leaves, tree branches, cartons, cans, and other similar materials are bulky if not thoroughly compacted, and consequently weigh relatively little per unit of volume. However, leaves, grass cuttings, and all garden rubbish in general shrink in volume and absorb moisture during decomposition, increasing the weight of rubbish per cubic yard where this material is not collected frequently. A preponderance of bottles, broken glass, metal objects of all kinds, plaster, broken brick, and other construction rubbis or building debris will cause rubbish to be much heavier.

As a rule the weight of rubbish will range from about 200 to 675 pounds per cubic yard, the median average being about 250 pou Data covering four municipalities are given in the following table

City	Tons Collected	Cubic Yards Collected	Pounds Per Cubic Yard
Hartford, Conn.	1,484	14,840	200
Regina, Sask.	5,588	52,150	225
Jacksonville, Fla.	46,528	195,205	477
Altoona, Pa.	1,282	3,784	677

1.14 Classification of Refuse Materials

In summary the following table gives the classification:

CLASSIFICATION OF REFUSE MATERIALS

Class	Description	Origin	Dispositi
	Wastes from the preparation, cooking, and consumption of food		
Garbage	Market refuse, waste from the handling, storage, and sale of produce		

CLASSIFICATION OF REFUSE MATERIALS (CONT'D)

Class		Description	Origin	Disposition
Refuse	Rubbish: Combustible rubbish	Paper Cartons, boxes barrels wood and excelsior Tree branches Yard trimmings Wood furniture Bedding	From homes, hotels, Institutions, stores, markets, etc.	Municipal responsibility for collection and disposal
	Non-Combustible rubbish	Metals Tin cans Metal furniture Dirt Glass Crockery Other mineral refuse		
	Ashes	Residue from fires used for cooking and for heating buildings		
	Street Refuse	Street sweepings Dirt Leaves Catch basin dirt Contents of litter receptacles	From Streets, sidewalks, alleys, vacant lots etc.	
	Dead Animals	Small animals: cats,dogs,etc. Large animals:horses,cows,etc.		
	Abandoned Automobiles			
	Industrial Refuse	Solid waste resulting from industrial processes and manufacturing operations, such as: food-processing wastes,boiler house cinders,lumber scraps and shavings,metal scraps and shavings, etc.	From factories power plants,etc.	Private responsibility for disposal

1,15 Changes In Composition of Refuse

The relative quantities of the various classification of refuse materials have changed considerably during the past 20 years and will probably continue to do so. The ratio of the percentage of garbage to combustible rubbish has changed from approximately 65 percent garbage and 35 percent rubbish to 35 percent garbage and 65 percent rubbish. In Washington, D.C. and New York, N.Y. the total amounts of garbage are in the vicinity of 10 percent of the total amounts of refuse produced.

The cause of this change is directly attributable to the change in the produce marketing methods. Fifteen to twenty years ago vegetables were purchased, it might be said in the raw, and when processed for cooking produced large amounts of waste materia. Today this has been replaced to a large extent with frozen foods, with disposable cardboard covers, and with canned foods. Even frozen citrus fruits have largely replaced the fresh fruits which produced large amounts of wastes. The quantities of garbage produced per capita are therefore far less today than they were 15 to 20 years ago. Rubbish materials, consisting of newspapers, carton bags, etc. have increased.

Changes have also been made in the use of fuels for house heating. Formerly many homes were heated by coal, but these are being replaced to a great extent with either new oil or gas burning furnaces, or the existing furnaces are being converted to oil or gas burners. Practically all new homes being constructed are now equipped with oil or gas burners. As a result of these changes the amounts of ashes produced are practically negligible in areas having high realty values.

CHAPTER 2

PRESENT REFUSE COLLECTION AND DISPOSAL PRACTICES

2.1 Sources of Information

The information and data contained in the survey of The Refuse Problem In Delaware County, made by The Pennsylvania Economy League has been carefully reviewed and spot checked. With practically no exceptions the collection remains as reported therein. As this is an essential part of the proposed disposal of refuse in Delaware County it has been copied and forms a part of this report.

2.2 Scope of Information

Of the 49 municipalities in Delaware County, 46 furnished information on refuse collection through the questionnaires. The three which did not are almost entirely rural. Observations were made in the field and pictures were taken. Tabulation of data received concerning refuse collection discloses the general conditions found.

2.3 Types of Vehicles

A substantial portion of all refuse collected in the county is done with open dump trucks. Thirty municipalities have all refuse collected in open trucks with but four stating that the loads are covered with tarpaulins. In addition, five others have a portion of their refuse collected in open trucks. Four municipalities claim that covered body trucks are used for all refuse and two more state that covered trucks are used for part of the refuse. Four municipalities claim that packer type trucks pick up part of their refuse. Public health authorities normally approv of only the latter two types.

2.4 Pickup Conditions

All refuse is picked up from the curb or alley in 21 municipalities. A portion of the refuse from 16 additional political subdivisions is also collected from the curb or alley. Twenty-two have some or all refuse picked up at the rear door, of which 6 have all refuse picked up at the rear door. Concerning the curb pickup location, it was observed that there was an apparent lack of enforced regulations covering conditions of storing refuse for pickup at the curb. The average refuse set out for collection consisted of a heterogeneous pile of paper cartons, bags, household articles and cans easily accessible to dogs, cats, rats and elements. This method of curb pickup is not an ideal refuse handling practice. Although economical, curb pickup, under best conditions, has disadvantages including unsightliness, tendency to cause litter, demand for rigid collection schedule and potential danger to public health when tampered with by dogs and children, plus the time and energy required of the individual householder to lug all refuse to a curb location and return the empty containers to the regular storage location.

Except for five municipalities, all garbage collected was picked up unwrapped as swill, apparently for hog feeding purposes. Normally it was set out at the curb in covered metal containers.

All rear door collections that exist include garbage. Four municipalities stated that their garbage and rubbish was picked up together.

A normal minimum specification of refuse storage for collection requires sturdy metal containers having tight fitting covers and limitations as to size, both minimum and maximum. Items collected which cannot be contained in metal covered cans, as discarded furniture and tree limbs, are usually limited in nature, size and weight. Garbage, when collected together with rubbish, should be drained and wrapped.

2.5 Frequency of Collections

Although information concerning frequency was not supplied by all municipalities, the 38 which did, present a fairly complete picture.

A summary of collection frequency follows:

Garbage	Municipalities
Once per week	4
Twice per week	19
Once per week in winter and twice per week in summer	7
Twice per week in winter and three times per week in summer	7
Rubbish	
Every other week	4
Once per week	24
Twice per week	4

It would appear logical to assume that the cost of collecting refuse twice a week would cost considerably more than collecting refuse once a week. Apparently, other facters more than compensate

Subdivision	Householder Contract	Mun. Cont.	Mun. Empl.	Annual Rate To Household	Freq. of Pickup (Monthly) G	R
Folcroft Boro		G & R		5.57	8	4
Glenolden Boro		G & R		3.95	8-12	4
Haverford Twp.		G	R	6.96	8	2
Lansdowne Boro	R	G		9.58	8	-
Lower Chichester Twp.		G & R		6.60	8	4
Marcus Hook Boro		G & R		6.28	-	-
Marple Twp.	G & R			21.00	9	9
Media Boro		G & R		11.00	8	4
Middletown Twp.	G & R			12.00	4	4
Millbourne Boro		G & R		9.25	8-12	4
Morton Boro		G & R		8.50	4	4
Nether Prov.Twp.	G & R			24.00	-	-
Newtown Twp.	G & R			24.00 20.00	8-12	4
Norwood Boro		G	R	3.96	2-3	-
Parkside Boro		G & R		4.52	-	-
Prospect Park Boro		G & R		5.48	8	4
Radnor Twp.			G & R	17.99	8	2
Ridley Twp.		G & R		6.44	4-8	4
Ridley Park Boro		G & R		5.45	8-12	2
Rose Valley Boro	G & R			24.00	8	8
Rutledge Boro		G & R		6.18	8-4	4
Sharon Hill Boro		G		3.61	-	-
Springfield Twp.		G	R	9.85	8	2
Swarthmore Boro	R	G		3.04	9	2
Thornbury Twp.	Pers.Disp.				-	-
Tinicum Twp.		G	R	8.57	4	4
Trainer Boro		G & R		5.18	4-8	-
Upland Boro		G & R		5.03	4-8	4
Upper Chichester Twp.		G & R		4.50	5	4-
Upper Darby Twp.		G	R	5.30	8	4
Upper Prov. Twp.	G			24.00	8	-
Yeadon Boro		G & R		7.30	8	4

Legend: R = Rubbish, G = Garbage

2.7 Schedule of Collection Contractors

The following gives the names of the collection contractors and the areas served as of 1953:

Contractor	Address	Customer Subdivisions	Length of Municipal Contract (Years)
Atz, William	Glen Mills Rd. Thornton, Pa.	Lansdowne Boro	1
		Sharon Hill Boro	9 mos.
Ball,Walter L.,Jr.	1825 Hook Rd.	Rutledge Boro	1
Bandurski,Stanley	Boothwyn, Pa.	Swarthmore Boro	Unknown
Barry, Steven and Soltys, S.W.	West Chester R.F.D.#1,Pa.	Upper Darby Twp.	1
		East Lansdowne Boro	1
Battipps,Samuel	60 S.Wallingford Ave. S.Media,Media,Pa.	Nether Prov. Twp.	None
Blosinker, Jean	Downington, R.F.D.,Pa.	Clifton Hts.Boro	1
		Yeadon Boro	2
Blosinski,J.& E.	Gradyville,Pa.	Media Boro	1
		Prospect Park Boro	1
		Newtown Twp.	None
		Middletown Twp.	None
Blosinski, Peter	Middletown Lima Post Office Pa.	Edgmont Twp.	None
Blunt, George	Morton, Pa.	Swarthmore Boro	None
Brooks, William	Morton, Pa.	Swarthmore Boro	None
Brown, J.R.	800 Fulton Ave. Sharon Hill,P.O., Pa.	Darby Twp.	1
Buckley Bros.	Brookthorpe Rd. Broomall Newtown Sq.Pa.	Marple Twp.	None
		Newtown Twp.	3
Clark, Birl	441 Washington Ave. S. Media, Media, Pa.	Nether Prov.Twp.	None
		Upper Prov. Twp.	None
		Rose Valley Boro	None

Contractor	Address	Customer Subdivisions	Length of Municipal Contract (Years)
Cormany, William	Delsea Drive New Sharon Sewell, N.J.	Haverford Twp. Upper Darby Twp.	3 1
Crispen, John	Folcroft, Pa.	Darby Twp. Folcroft Boro	1 1
Darczuk, Stefan	Zebley Road Boothwyn, Pa.	Eddystone Boro Tinicum Twp.	1 2
DeFrank, Anthony	Garnet Mine Rd. Boothwyn, Pa.	Marcus Hook Boro Morton Boro Parkside Boro	2 1 1
Demko Bros.	R.F.D. #1 Boothwyn, Pa.	Aston Twp. Springfield Twp. Upland Boro	2 3 1
Dickerson, Joseph	Morton, Pa.	Swarthmore Boro	None
Donato, Cameron	Milmont Ave., Milmont Park, Pa.	Chester City Lower Chichester Twp. Media Boro Prospect Park Boro Ridley Twp.	4 2 1 1 2
Dorsey, Morris	807 Forest Ave. S. Media, Media, Pa.	Nether Prov. Twp. Upper Prov. Twp.	None None
Elko, John	Pitman, N. J.	Upper Darby Twp.	1
Garnet		Middletown Twp.	None
Grobes, R.W.	1500 Remington St. Chester, Pa.	Nether Prov. Twp. Swarthmore Boro	None None
Henry, William	Westville, N. J.	Upper Darby Twp.	1
Jacobs, Elmer and McCain, C.	46 Evergreen Ave. Newtown Sq., Pa.	Marple Twp. Newtown Twp.	None None
Jasienski Bros.	Reed & Burmont Rds. Marple, Pa.	Upper Darby Twp.	1

Contractor	Address	Customer Subdivisions	Length of Municipal Contract (Years)
Kinsley, R.	Sewell, N. J.	Collingdale Boro	1
Klodarska, Edward	1510 Steel Rd. Havertown, Pa.	Marple Twp.	None
Knight, Heintzel	921 Chestnut St. Trainer, Pa.	Trainer Boro	1
Kuliszewski, John	338 Novis St. Chester, Pa.	Upland Boro Upper Chichester Twp.	1 6 mo
Lafferty, Edward & Sons	Cook & Academy Ave. Glenolden, Pa.	Aldan Boro Darby Boro	1 1
Land, Martin	Bethel Road Glen Mills Pa.	Colwyn Boro Norwood Boro Ridley Twp.	1 2 2
McCann, R.J.	1010 Concord Ave. Chester, Pa.	Ridley Park Boro Upper Chichester Twp.	10 mo 9 mo
Matthews, Elton	309 N.Horton St. Phila., Pa.	Millbourne Boro	1
Messina, Charles	7700 Holstein St. Phila., Pa.	Collingdale Boro Clifton Hts.Boro Darby Boro Yeadon Boro	1 1 1 2
Morris, Patrick	Paxon Hollow Road Media, Pa.	Marple Twp.	None
Ockiney, Charles	516 Brobbs Ave. Glenolden, Pa.	Lansdowne Boro	None
Orm, Elmer	538 Vernon Street Media, Pa.	Nether Prov.Twp.	None
Phillips, Norman E.	412 Lafayette Ave. Collingdale, Pa.	Lansdowne Boro	None
Pierce, Warren	349 S.Swarthmore Ave., Swarthmore, Pa.	Swarthmore Boro	None
Piner, Frazer	180 Bonsall Ave. Sharon Hill, Pa.	Lansdowne Boro	None

Contractor	Address	Customer Subdivisions	Length of Municipal Contract (Years)
Pratt, George	512 Grobes Ave.	East Lansdowne Boro	1
	Glenolden, Pa.	Ridley Park Boro	1
Rineer, Paul S.	Boothwyn, Pa.	Aston Twp.	2
	R.F.D. #1	Brookhaven Boro	1
	Glen Mills, Pa.	Chester Twp.	1
		Glenolden Boro	1
Roswora, Thomas	Boothwyn Road	[illegible]	
	Chester, Pa.	Glenolden Boro	1
Schreek, Wm.	West Goshen	Haverford Twp.	3
	West Chester, Pa.		
Seeney, John L.	804 Washington Ave.	Nether Prov. Twp.	None
	Moylan P.O., Pa.	Rose Valley Boro	None
Seeney, Sylvester	8 Morton Avenue	Nether Prov. Twp.	None
	Morton, Pa.	Rose Valley Boro	None
		Swarthmore Boro	None
Smith & Son, J.R.	Colwyn, Pa.	Colwyn Boro	1
Super, Nicholas	Ceder & Delsea	Chester City	4
	Westville Grove		
	N. J.		
Thomas, Richard		Upper Prov. Twp.	None
Weems, Linton	Harding Ave.	Nether Prov. Twp.	None
	Morton, Pa.		

2.8 Disposal of Refuse

Five principal methods of municipal refuse disposal are known to exist in Delaware County, three of which are practiced on a municipal basis. In addition, it is quite possible that some composting is being done on an individual household basis. The three methods utilized by municipalities are hog feeding of garbage, open dumping of all refuse and incineration of combustible refuse.

Individual household incineration, over which quality control by the municipality is very difficult, and grinding of garbage with individual sink disposals which discharge into sewers, are the legitimate methods mentioned which are not practiced on a municipal basis.

Incineration, together with depositing of incinerator residue and noncombustible rubbish in open dumps, is performed municipally in only one political subdivision. That municipality is now planning to remodel its equipment so that garbage can also be burned in its incinerator plant.

Thirty-eight political subdivisions stated that their garbage was disposed of by feeding to hogs. Raw garbage feeding is not a complete method. Hogs eat only a portion and the rest has to be disposed of by some other method. Although Pennsylvania now has a law controlling conditions of both housing and feeding, the average hog farm observed in Delaware County has much to be desired in sanitation appearance.

Forty-seven municipalities indicated that their rubbish was deposited in malodorously smoking, unsightly, rat infested and fly breeding, open dumps, although one identified the disposal operation as a modified landfill. Four municipalities, as previously stated, indicated that their garbage and rubbish were collected together, which suggests that they dispose of their garbage by the same method that they use for disposing of their rubbish. The method of disposal indicated by three of the four subdivisions' questionnaires is by deposit in an open dump.

The locations of the previous refuse disposal facilities are given in the following tabulation.

Subdivision Using	Disposal Location	Type
Aldan Boro	Hook Road, Darby Twp.	Open Dump
Aston Twp.	Bullens Lane, Ridley Twp. Boothwyn, Upper Chichester Twp.	Open Dump Piggery
Bethel Twp.	Garnet Mine Rd., Bethel Twp.	Open Dump
Birmingham Twp.	Chadds Ford, Birmingham Twp.	Open Dump
Brookhaven Boro	Crum Lynne, Ridley Twp.	Open Dump
Chester City	Westville Grove, N.J. Milmont Park, Ridley Twp.	Piggery Open Dump
Chester Twp.	Boothwyn, Upper Chichester Twp. Bullens Lane, Ridley Twp.	Piggery Open Dump
Chester Hts. Boro	Unknown	
Clifton Hts. Boro	Hook Road, Darby Twp. 7700 Holstein Ave. Phila.	Piggery Open Dump
Collingdale Boro	Southwest Philadelphia	Open Dump
Colwyn Boro	Colwyn Boro	Open Dump
Concord Twp.	Chadds Ford, Birmingham Twp.	Open Dump
Darby Boro	7700 Holstein Ave., Phila.	Open Dump
Darby Twp.	Hook Rd. & Darby Creek, Darby Twp.	Open Dump
East Lansdowne Boro	West Chester, Pa.	Piggery
Eddystone Boro	Bullens Lane, Ridley Twp. 8th St. & Ridley Creek Eddystone Boro	Open Dump Open Dump
Edgmont Twp.	Forge & Middletown Rd. Middletown, Twp.	Open Dump
Folcroft Boro	Unknown	

Subdivision Using	Disposal Location	Type
Glenolden Boro	West Chester, Pa. Boothwyn Rd.Chester, Pa.	Open Dum Piggery
Haverford Twp.	West Chester Pk. & Darby Creek Haverford Twp.	Incinerat and dump
Lansdowne Boro	Unknown	
Lower Chichester Twp.	Bullens Lane, Ridley Twp.	Dump
Marcus Hook Boro	Boothwyn,Upper Chichester Twp. Milmont Park, Ridley Twp.	Piggery Dump
Marple Twp.	Reed Road, Marple Twp.	Dump
Media Boro	Bullens Lane, Ridley Twp. Gradyville, Edgmont Twp.	Dump Piggery
Middletown Twp.	Unknown	
Millbourne Boro	Southwest Philadelphia	Dump
Morton Boro	Boothwyn,Upper Chichester Twp.	Piggery
Nether Prov. Twp.	Bullens Lane, Ridley Twp.	Dump
Newtown Twp.	Hook Road, Darby Twp.	Dump
Norwood Boro	Norwood Park & Darby Creek Norwood Boro Bethel	Dump Piggery
Parkside Boro	Unknown	
Prospect Park Boro	Gradyville, Edgmont Twp. Milmont Park, Ridley Twp.	Piggery Dump
Radnor Twp.	Hook Rd.&Darby Cr.Darby Twp. Belvoir Rd.,Plymouth Twp. Montgomery County,Pa.	Dump Piggery
Ridley Twp.	Bethel Rd., Glen Mills Bullens Lane, Ridley Twp.	Piggery Dump
Rose Valley Boro	Unknown	
Rutledge Boro	Unknown	
Ridley Park Boro	Philadelphia Boothwyn, Upper Chichester	Dump Piggery

Subdivision Using	Disposal Location	Type
Sharon Hill Boro	Unknown	
Springfield Twp.	84 Saxer Ave.Springfield Boothwyn,Upper Chichester	Dump & Fill Piggery
Swarthmore Boro	Hanby's Corner,Delaware	Piggery
Thornbury Twp.	Personal Disposal	
Tinicum Twp.	City Dump, Tinicum	Dump
Trainer Bor.	Hanby's Corner, Delaware	Piggery
Upland Boro	Boothwyn,Upper Chichester Twp.	Piggery
Upper Chichester Twp.	Unknown	
Upper Darby Twp.	Hook Road, Darby Twp. West Chester, Pa. Pitman, N. J. Sewell, N. J. Westville, N. J.	Dump Piggery Piggery Piggery Piggery
Upper Providence Twp.	Unknown	
Yeadon Boro	Downington, Pa. 7700 Holstein Ave.,Phila.,Pa.	Piggery Open Dump

2.9 List of Haulers

In the intervening period since the issue of the report by The Pennsylvnnia Economy League, some changes have occurred in respect to the dumps in use and the personnel engaged in hauling refuse. The active dumps and piggeries are indicated in the Appendix.

Returns from a questionnaire addressed to each of the municipalities gave the haulers and cost basis on which the respective contracts for hauling were made. From a total of 49 municipalities

5 did not reply; they are as follows;

Eddystone Boro
Marple Twp.
Media Boro
Newtown Twp.
Upper Providence Twp.

An additional 5 municipalities advised that there was no organized collection service in effect. In some cases a dump is available to the householder at certain periods, and in other cases disposition of refuse is arranged by the householder through hauler or otherwise. These municipalities are as follows:

Bethel Twp.
Birmingham Twp.
Concord Twp.
Edgmont Twp.
Thornbury Twp.

The 39 municipalities making reply listed the haulers for garbage and refuse respectively, and supplied information as to the contract price involved. The following list identifies those replying together with the names of haulers engaged in the services

Municipality	Hauler		
Aldan Boro	E. Lafferty & Sons	G & R	
Aston Twp.	Demko Bros	G	
	Louis Bruni		R
Bethel Twp.	No collection		
Birmingham Twp.	No collection		
Brookhaven Boro	Marty DeFrank	G & R	
Chester City	Nicholas Super	G	
	Cameron Donato		R
Chester Hts. Boro	Household contracts	G & R	
Chester Twp.	Wm. Demko	G	
	Marty DeFrank		R
Clifton Hts. Boro	Wm. Demko	G	
	Charles Messina		R
Collingdale Boro	Daniel Kinsley	G	
	Norman Phillips		R

Municipality	Hauler	G	R
Colwyn	Stanley Bandurski	G	
	John Kuliszewski		R
Concord Twp.	No collection		
Darby Boro	Wm. Atz	G	
	John Leonard		R
Darby Twp.	Wm. Demko	G	
	George Pratt		R
East Lansdowne Boro	Wm. Demko	G	
	John Kuliszewski		R
Eddystone Boro	No Reply		
Edgmont Twp.	No collection		
Folcroft Boro	Walter & Robt. Adams	G	
	John Kuliszewski		R
Glenolden Boro	E. Lafferty & Sons	G	
	John Kuliszewski		R
Haverford Twp.	George Barry) James Butler) Wm. H. Schreck) Jos. Blosenski)	G	
	Municipal		R
Lansdowne Boro	Stephen Barry	G	
	8 private collectors		R
Lower Chichester Twp.	Cameron Donato	G &	R
Marcus Hook Boro	Tony DeFrank	G &	R
Marple Twp.	No reply		
Media	No reply		
Middletown Twp.	Various private	G &	R
Millbourne Boro	E. Matthews	G &	R
Morton Boro	Wm. Demko	G	
	Municipal		R
Nether Prov. Twp.	Morris Dorsey	G &	R
Newtown Twp.	No reply		
Norwood Boro	Martin Land	G	
	Municipal		R
Parkside Boro	Marty DeFrank	G &	R
Prospect Park Boro	Charles Schumm) Christian Walter)	G	
	Cameron Donato		R

Municipality	Hauler	G	R
Radnor Twp.	Municipal	G & R	
Ridley Park Boro	Raymond J. McCann	G	
	John Kuliszewski		R
Ridley Twp.	Martin Land & Sons	G	
	Cameron Donato		R
Rose Valley Boro	Sylvester Seeney)		
	Samuel W. Battipps)	G & R	
	Morris Dorsey)		
	Birl C. Clark)		
Rutledge Boro	Stanley Bandurski	G	
	Walter L. Ball		R
Sharon Hill Boro	Wm. Atz	G	
	Municipal		R
Springfield Twp.	Edward M. Seder	G	
	Municipal		R
Swarthmore Boro	Stanley Bandurski	G	
	Wm. Brooks)		
	Sylvester Seeney)		R
	Warren Pierce)		
	L. W. Grobes *		
Thornbury Twp.	No collection		
Tinicum Twp.	Frank Darczuk	G	
	Municipal		R
Trainer Boro	Stanley Bandurski	G	
	Municipal		R
Upland Boro	Walter & Robt. Adams	G	
	George Pratt		R
Upper Chichester Twp.	Wm. Demko	G	
	Municipal		R
Upper Darby Twp.	Municipal	G & R	
Upper Prov. Twp.	No reply		
Yeadon Boro	Jane Blosinski	G	
	Charles Messina		R

Legend: G = Garbage; R = Rubbish

No reply 5; total 49 - no collection 5.

2.10 Cost of Hauling

With the practices prevailing in Delaware County, the term "Hauling" means for the most part, disposition of refuse, as well. In some cases the hauler is operating his own dump, while in other cases a charge per load is fixed by the dump operator. In either case, the charge is increasing from year to year depending on the term of the contract.

A review of the replies to the questionnaire shows that the contract price is widely variable, depending upon the location available for dumping and the route mileage involved. Four dumps have been closed since the issue of the Pennsylvania Economy League Report in 1953, either because of being filled or because of protestations of neighborhood residents. It is estimated that only 7 dumps are in active service at this time and some of these are approaching a filled condition. A sizeable amount of refuse is presently disposed of outside the County, thus adding to the cost.

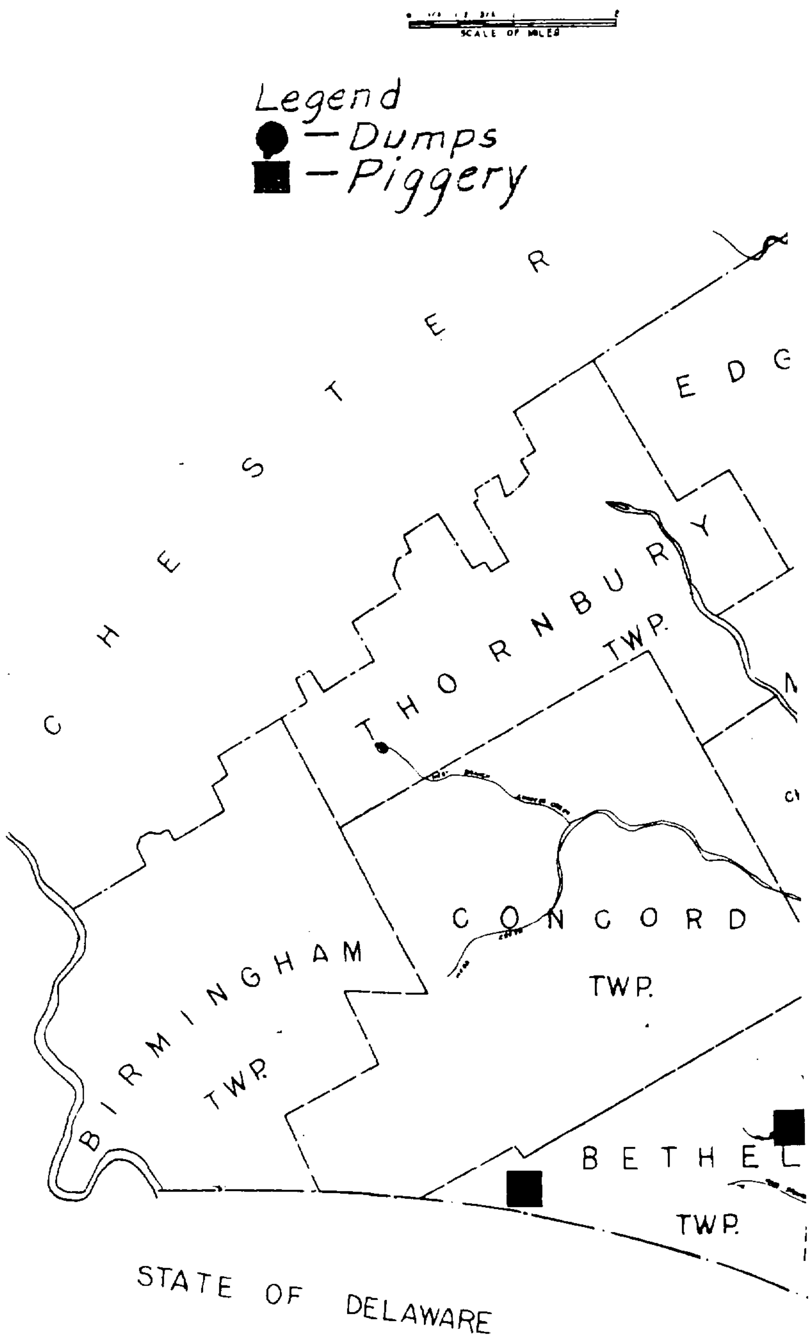
Following is a summary of the contract price reported:

Delaware County, Penna.	Garbage Year	Rubbish Year
Aldan Boro	$ 3,966.00	$ 7,734.00
Aston Twp.	3,600.00	9,000.00
Bethel Twp.	----- --	----- --
Birmingham Twp.	----- --	----- --
Brookhaven Boro	1,750.00	5,250.00
Chester City	39,750.00	103,333.33
Chester Twp.	2,800.00	6,950.00
Chester Heights Boro	----- --	----- --
Clifton Heights Boro	3,500.00	10,350.00
Collingdale Boro	3,640.00	10,650.00

Delaware County, Penna.	Garbage Year	Rubbish Year
Colwyn Boro	$ 979.00	$ 3,000.00
Concord Twp.	--- --	--- --
Darby Boro	4,200.00	15,000.00
Darby Twp.	4,560.00	16,500.00
East Lansdowne Boro	2,388.00	5,000.00
Eddystone Boro	----- --	----- --
Edgmont Twp.	----- --	----- --
Folcroft Boro	3,200.00	5,000.00
Glenolden Boro	5,200.00	9,000.00
Haverford Twp.	63,743.88	85,756.22
Lansdowne Boro	2,997.00	8,991.00
Lower Chichester Twp.	1,725.00	5,175.00
Marcus Hook Boro	650.00	6,737.50
Marple Twp.	----- --	----- --
Media Boro	----- --	----- --
Middletown Twp.	----- --	----- --
Millbourne Boro	975.00	2,925.00
Morton Boro	297.00	981.00
Nether Providence Twp.	----- --	----- --
Newtown Twp.	----- --	----- --
Norwood Boro	3,060.00	6,000.00
Parkside Boro	1,223.75	3,671.25
Prospect Park Boro	3,400.00	7,488.00
Radnor Twp.	5,000.00	2,400.00
Ridley Twp.	12,000.00	39,626.00
Ridley Park Boro	4,490.00	8,000.00
Rose Valley Boro	----- --	----- --
Rutledge Boro	1,500.00	2,100.00
Sharon Hill Boro	4,200.00	----- --
Springfield Twp.	31,475.00	49,000.00
Swarthmore Boro	8,000.00	----- --
Thornbury Twp.	----- --	----- --
Tinicum Twp.	2,400.00	----- --
Trainer Boro	960.00	----- --
Upland Boro	1,000.00	4,950.00
Upper Chichester Twp.	3,360.00	9,000.00
Upper Darby Twp.	60,000.00	250,000.00
Upper Providence Twp.	----- --	----- --
Yeadon Boro	9,408.00	16,672.00
Total -	$ 301,397.63	$ 716,240.30

DELAWARE COUNTY INCINERATOR
DELAWARE COUNTY, PENN

DAMON & FOSTER
CONSULTING ENGINEERS
SHARON HILL, PA.
COTTON, PIERCE, STREANDER, INC.
ASSOCIATE ENGINEERS
NEW YORK CITY, N.Y.
MARCH 1956



From the foregoing, we arrive at a total of $301,397.63 for disposition of garbage, and $716,240.30 for rubbish, making a grand total of $1,017,637. To this figure should be added the various household and commercial contracts which, it is estimated, will bring the total to $1,250,000.00.

The replies have been reporduced and are to be found in the Appendix.

2.11 LOCATION OF PRESENT REFUSE DISPOSAL FACILITIES

It is seen that disposal practices vary widely. Fig. 3 shows the active dumps and piggeries now operating within the County.

CHAPTER 3

POPULATION STUDIES

3.1 Need for Studies

Future forecasts are required to determine the population that must be served by the proposed refuse disposal facilities. These have been made to the year 1980 as this probably represents the maximum foreseeable time for which the disposal facilities should be planned. Changes in the environmental factors of the county, which may cause a change in the quantities of anticipated refuse, make forecasts of populations and refuse quantities beyond the year 1980 difficult to ascertain.

3.2 Present Environmental Factors

Delaware County has a land area of about 185 square miles. It is the second smallest county in the state, but has the third largest population as based on the 1950 U.S. Census. It has large residential areas varying from large estates in the northeastern township to sections consisting of block after block of row houses such as obtained in the City of Chester and to a lesser extent in other municipalities of the county. The county has the third largest total dollar value industrial output and the largest per capita industrial output in the state. Most of the wage earners live in the county. Many of the residents are employed in the nearby businesses and industries of Pennsylvania and Delaware.

The industrial statistics of the county for the year 1950 were as follows:

settling out as an objectionable coating that litters the neighborhood and produces complaints from the citizenry. A combination of carefully designed expansion chamber, baffle walls, checker flues, and particulate control systems should effectively maintain fly ash and stack gas quality within workable limits.

An effective method of dust and smoke control is in use at the Framingham plant. A Peabody type spray impinge is installed in each furnace outlet. Water that has been used for the cooling of the water tube walls is piped to the scrubbers and flows down through the scrubber through a series of small openings. An induced air draft fan pulls the flue gas through the scrubbers in an opposite direction to the flow of the water. This causes the flue gas to pass through myriad drops of water which wet and knock down the small particles of fly ash contained in the gaseous products of combustion. Approximately 3000 gallons of water are required per ton of incinerator capacity for high efficiency wet scrubbing with an outlet temperature of about 200°F.

The design of the Philadelphia Harrowgate incinerator plant provides a dust eliminator in the main flue ahead of the two chimneys. Each eliminator has three rows of water sprays, each row having five nozzles on the top and sides of the chamber. The bottom of the chamber is in the form of a pond, on which the gas stream is directed. The dirty water is drained off to a settling chamber and then to the storm sewer. The discharge end of the dust eliminator is provided with baffles which present a staggered impingement surface to the gas travel to reduce moisture entrainment carryover.

It is stated that between 1,500 and 2,000 gallons of water are required per ton of plant capacity for obtaining proper condition and an outlet temperature of about 600° F.

The foregoing incinerator design features and means provided for dust and fly ash removal, removes the aerial nuisance aspects of the usual incinerator plant. This, together with a pleasing appearing plant structure and good housekeeping in its operation, should allow the locating of the incinerator plants in comparatively close proximity to residential areas.

CHAPTER 6

STUDIES OF REFUSE INCINERATION

6.1. NUMBERS OF PLANTS

6.1.1. PLANT LOCATION

As Delaware County has an area of some 185 square miles, with population densities varying from sparse to thickly settled, it is at once apparent that a single incinerator plant, while the least costly, would not from a cost of collection standpoint, be economically feasible. In an area such as this it is generally not advantageous to build one large incinerator plant, but rather to construct smaller units strategically located in reference to population densities and lengths of haul. Studies were therefore made of various numbers of plants ranging from two to four.

The locations and areas to be served by each of the plants are shown on the plans describing each incinerator plan and are as follows:

SCHEME A - TWO PLANTS LOCATED AS FOLLOWS:

District A - Upper Darby Township, adjacent to Darby Creek and nearby Garrett Road.

District B - Aston Township, adjacent to Chester Creek and nearby Pennell Road.

SCHEME B - THREE PLANTS, LOCATED AS FOLLOWS:

District A - Haverford Township, at the site of its existing incinerator plant nearby Darby Creek.

District B - Glenolden Borough, adjacent to Muckinipates Creek and nearby Chester Pike.

District C - Aston Township, adjacent to Chester Creek and nearby Village Green Road.

SCHEME C - FOUR PLANTS LOCATED AS FOLLOWS:

District A - Haverford Township, at the site of its incinerator plant nearby Darby Creek.

District B - Glenolden Borough, adjacent to Muckinipates Creek and nearby Chester Pike.

District C - Aston Township, adjacent to Chester Creek and nearby Brookhaven Road.

District D - Thornbury Township, adjacent to Chester Creek and nearby Forge Road.

It is to be noted that most of the foregoing plant locations may be termed hillside locations allowing the economical use of two level plants. They are adjacent to streams or creeks from which an ample supply of water is available for water spray control of dust and fly ash. The water supply from Muckinipates Creek for the Glenolden Plant is quite low during the summer months and for this location the effluent from the Muckinipates Authority Sewage Treatment Plant would be used as the source of water for dust and fly ash control. Sufficient areas are available at these sites for settling ponds to remove the dirt contained in the water from the dust and fly ash removal devices. There is also sufficient area available at each site for the dumping of the ash and clinker resulting from the burning of the refuse for many years in the future.

Class of Industry	No. of Establishments	Total No. of Employees	Total Wages and Salaries	Capital Invested	Value of Products
Chemicals & allied products	26	6,145	$ 25,611,300	$ 63,367,000	$337,774,600
Clay, Glass & Stone products	13	266	832,600	999,500	3,048,600
Food & kindred products	53	960	2,304,300	3,003,400	14,439,300
Leather & rubber goods	5	104	402,300	213,400	1,438,400
Lumber & its manufacture	27	643	1,605,100	2,001,100	9,899,300
Metals & metal products	92	21,879	77,054,700	90,601,700	359,152,200
Mine & quarry products	11	176	563,900	960,700	1,680,200
Paper & printing industries	45	3,865	15,048,100	35,965,800	85,359,800
Textiles & Textile products	41	8,169	20,381,200	23,804,500	76,542,200
Tobacco & its products	--	- ---	-- --- --	-- --- ---	-- --- ---
Miscellaneous products	40	5,768	19,104,400	32,445,000	55,858,100
Railroad repair shops	5	329	1,107,300	1,714,400	1,493,800
Grand Total	358	48,304	$164,015,200	$255,076,500	$946,686,500

The above figures, for the year 1950, were compiled by the Bureau of Statistics, Department of Internal Affairs, Commonwealth of Pennsylvania.

1.3.3 Methods of Forecasting Populations

There have been five standard methods of forecasting future population in use for the design of water and sewage works, transportation and other municipal facilities in order to design these for a reasonably useful life. There are as follows:

1 - Arithmetical Progression
2 - Geometrical Progression
3 - Decreasing Rate of Increase
4 - Graphical Extension
5 - Graphical Comparison

Arithmetical progression assumes a constant annual increase increment between two census years and the increase between census years, divided by ten give the annual increase. This method of estimating future population is simple and easily understood, but it is one that, however, cannot be extended far into the future.

Geometrical progression is the forecasting of population in a manner similar to that of money at compound interest except that the interest is being added constantly instead of annually. This method gives a higher future population than the arithmetical progression method for the post census years. Decreasing rate of increase is based on the assumption that the rate of increase decreases as the population increases being somewhat similar to the financial law of decreasing returns.

Graphical extension and comparison consists of extending future populations on the basis of comparisons with other cities of similar type to the one under consideration. Rates of increase are taken for these and the points of beginning are taken as of similar populations. The future growth is then assumed to follow the average increases of those chosen for comparison.

These methods are, however, influenced by other factors. No city or town grows in exact accordance with the arithmetical or the geometrical progression methods. Comparisons made with the past growth of other similar municipalities may be misleading due to the many factors that may have influenced the previous growths of these. It is of course generally true that as municipalities become larger the annual rate of increase becomes less. Changes in transportation, methods of housing, general economic conditions, industrial development also influence the problem. Therefore, while mathematical analysis are helpful, the conclusions reached must be tempered with judgment and based on a study of local conditions, general living environment and in areas such as Delaware County, on industrial development and its effect on economic opportunity and stability.

3.4 Past Populations of County

The past population growth of the County has been consistent, with each census showing a substantial increase. Past populations are only extended back to the year 1870 as with the exception of the City of Chester and some of the other municipalities, it was largely rural prior to this time.

Populations from the years 1870 to 1950 were as follows;

		Increase per Decade	
Year	Population	Numerical	Percent
1870	47,979	---	---
1880	56,101	8,122	17
1890	74,683	18,582	33
1900	94,762	20,079	27
1910	117,906	23,144	27.4
1920	173,084	52,178	44.3
1930	280,264	107,180	61.9
1940	310,756	30,492	10.9
1950	414,234	103,478	33.3
* 1955	501,410	87,176 (5 years)	

*Estimated

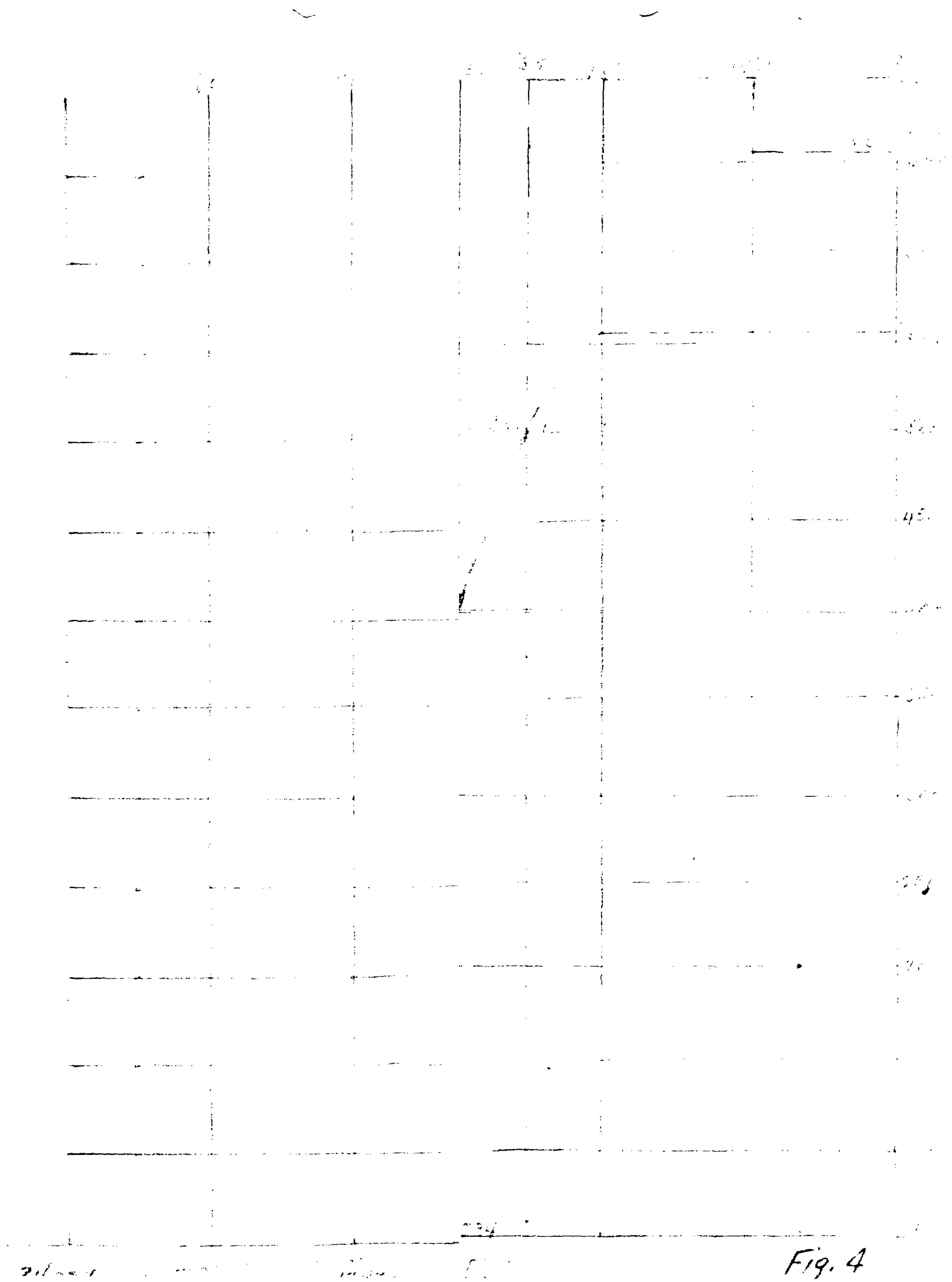


Fig. 4

3.5 Estimated Future Populations of County

If a population is expanding in a society of unlimited economi opportunity, the rate of increase is comparatively constant. If it is expanding in an area of limited economic opportunity, the rates of increase must tend to get less and less as the population grows, so the rate of increase is then some function of the population itself, limited by the level of economic opportunity.

For the past number of years there has been a generally consta increase in the industrial economy of the county. There probably will be a continuing increase in this activity for the next 10 to 15 years, but after this it may increase or remain stationary, and for that matter it may decrease. This must be considered in forecasts of future populations as well as trends in the housing construction activities, available land and other factors.

Each of the 49 political sub-divisions of the county were studied to ascertain rates of past growths, available land for home construction. The results of these studies are shown graphically for each sub-division in the appendix to this report. Based on these and a continuing industrial activity for the next 10 to 15 years after which it would decrease, the future population of the county has been estimated to be as follows:

Year	Population	Increase per Decade Numerical	Increase per Decade Percent
1955	501,410	----	----
1960	560,450	58,800	11.7
1970	657,595	97,145	17.3
1980	703,690	46,095	6.9

The foregoing past and estimated future populations are show graphically on Figure No. 1.

3.6 Populations of Political Sub-Divisions

As previously stated past populations were secured from the U.S. Census Bureau for each census year. These were carefully studied to indicate the past rates of growth of each sub-division and projected to indicate future rates of population increase. Consideration was given in the forecasts for future population to such factors as available land for realty development, closeness to industry, possible industrial growth and development, desirability of land, etc.

The estimated future populations of each sub-division, arranged in alphabetical order, are given in the following tabulation:

Sub-Division	POPULATIONS 1955	1960	1970	1980
Aldan Borough	4,140	4,400	4,790	4,900
Aston Township	6,740	8,350	11,000	14,000
Bethel Township	1,700	2,320	3,600	5,600
Birmingham Township	920	1,800	3,350	5,000
Brookhaven Borough	3,030	4,100	6,000	8,000
Chester Heights Borough	490	700	2,250	3,000
Chester Township	4,080	6,250	11,350	12,000
City of Chester	70,280	73,500	76,500	78,000
Clifton Heights Borough	8,040	8,400	8,900	9,000
Collingdale Borough	10,000	10,700	10,900	11,000
Colwyn Borough	2,200	2,300	2,460	2,700
Concord Township	2,300	3,200	6,000	7,000
Darby Borough	14,120	14,600	14,800	15,000
Darby Township	9,990	11,900	13,600	14,000
East Lansdowne Borough	3,610	3,700	3,760	3,800
Eddystone Borough	3,230	3,400	3,600	3,800
Edgmont Township	1,280	2,100	3,500	5,000
Folcroft Borough	4,430	5,700	7,300	8,000
Glenolden Borough	7,410	8,000	8,350	8,400
Haverford Township	49,460	55,000	64,000	68,000
Lansdowne Borough	12,940	13,600	14,000	14,100
Lower Chichester Township	3,350	3,950	5,160	7,000
Marcus Hook Borough	3,870	3,870	3,950	4,000
Marple Township	11,180	15,600	22,000	27,500

Sub-Division	1955	1960	1970	1980
Media Borough	6,250	6,800	7,000	7,200
Middletown Township	7,140	8,500	16,850	20,000
Millbourne Borough	900	910	925	940
Morton Borough	1,800	1,900	1,950	2,000
Nether Providence Township	8,220	12,500	15,300	16,000
Newtown Township	6,290	10,800	18,600	20,000
Norwood Borough	5,660	5,840	5,920	6,000
Parkside Borough	2,080	2,230	2,300	2,350
Prospect Park Borough	6,480	7,000	7,500	7,600
Radnor Township	18,370	22,000	28,200	30,000
Ridley Township	26,800	30,000	31,400	32,000
Ridley Park Borough	6,580	7,400	7,760	7,800
Rose Valley Borough	560	620	990	1,150
Rutledge Borough	950	960	980	1,000
Sharon Hill Borough	6,500	7,000	7,500	7,700
Springfield Township	21,650	25,400	28,800	30,000
Swarthmore Borough	5,830	6,120	6,250	6,300
Thornbury Township	2,370	2,750	4,300	6,000
Tinicum Township	5,800	5,900	6,350	6,400
Trainer Borough	2,080	2,200	2,600	2,850
Upland Borough	4,840	5,200	6,000	6,400
Upper Chichester Township	7,740	9,050	18,000	21,000
Upper Darby Township	91,280	94,300	98,000	100,000
Upper Providence Township	4,980	6,180	10,900	12,000
Yeadon Borough	11,470	11,450	12,100	12,200
Totals	501,410	560,450	657,595	703,090

The foregoing populations for each municipality are shown graphically in the Appendix.

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CHAPTER 4

QUANTITIES OF REFUSE

4.1 SOURCES OF INFORMATION

The results of the questionnaires sent out by the Economy League to the 49 political sub-divisions in the County indicate that there are practically no accurate records kept of the amounts of refuse collected and disposed of. As given in its report, five of 49 stated they kept some form of record, two of the returns gave the quantities in cubic yards which, due to the variations in weight, is not accurate. This is readily understandable as with the contract method of collection and disposal of refuse the municipality is not interested in tonnage but in the contract price.

Those having some knowledge of the amounts collected are the collecting contractors. They, however, consider their costs in terms of truck loads rather than in tons. The contractor collecting refuse in the City of Chester keeps fairly accurate records of the truck loads of refuse collected. A program of truck weighing was set up and by means of this a determination was made of the daily tonnage collected. Upper Darby Township made a recent survey of the weight of refuse collected for determining the capacities of the incinerator plant it has under consideration for construction. The data collected from these sources were averaged and a determination was made of the amount of refuse for disposal in pounds per capita per day. This factor was then used to determine the capacities of the various methods of refuse disposal studied in this report.

4.2 RESULTS OF CHESTER INVESTIGATIONS

The City of Chester lets contracts for the collection of rubbish and garbage. Rubbish is collected five (5) days per week all the year and garbage is collected six (6) days per week during the summer months and five (5) days per week during the winter months.

The amounts of rubbish collected average as follows:

Days of Week		Tons per day
Summer (July, August and September)		
Monday		66.00
Tuesday		66.00
Wednesday		84.00
Thursday		72.00
Friday		84.00
	Total per week	372.00 tons
	Average per day	74.40 "
	Peak day	84.00 "
Winter (October through June)		
Monday		82.50
Tuesday		87.25
Wednesday		108.75
Thursday		91.00
Friday		112.50
	Total per week	482.00 tons
	Average per day	96.40 "
	Peak day	112.50 "

Based on the foregoing quantities the total amount of rubbish collected per year would be as follows:

Summer collection	13 weeks at 372 tons	4,836 tons
Winter collection	39 weeks at 482 tons	18,798 "
	Total per year	23,634 "

The operation of the incineration plants is based on the burning of the refuse for 300 days per year. On this basis the average tons per day and the per capita amounts are as follows:

Tons per day	78.78
Pounds per capita per day	2.24

The amounts of garbage collected average as follows:

Summer (May through September)

Monday	40.0 tons
Tuesday	25.0 "
Wednesday	40.0 "
Thursday	12.5 "
Friday	12.5 "
Saturday	40.0 "
Total per week	170.00 "
Average per day	28.33 "
Maximum day	40.00 "

Winter (October through April)

Monday	25.0 tons
Tuesday	20.0 "
Wednesday	10.0 "
Thursday	15.0 "
Friday	30.0 "
Total per week	100.0 "
Average per day	20.0 "
Peak day	30.0

Based on the foregoing quantities the amounts of garbage collected per year are as follows:

Summer collections 21 weeks at 170 tons	3,570 tons
Winter collections 31 weeks at 100 tons	3,100 "
Total per year	6,670 "

With 300 incinerator plant operating days the average tons per day and the per capita amounts are as follows:

Tons per day	22.23
Pounds per capita per day	0.63

The totals of the foregoing averages are as follows:

	Tons per day	Pounds per capita
Rubbish	78.78	2.24
Garbage	22.23	0.63
Totals	101.01	2.87

The variations between winter and summer collections are as follo

		Tons per day	Pounds per capita per day	Percent
Summer -	Rubbish	74.40	2.11	72.4
	Garbage	28.33	0.80	27.6
	Totals	102.73	2.91	100.0
Winter -	Rubbish	96.4	2.74	82.8
	Garbage	20.0	0.56	17.2
	Totals	116.4	3.30	100.0

The peak day collections of rubbish and garbage are as follows:

	Summer	Winter
Rubbish	84 tons (Wed.)	112.50 (Friday)
Garbage	40 " "	30.00 "
Totals	124 "	142.50

The foregoing indicates that the days of maximum collections are somewhat different for summer and winter collections. This equal 4.05 pounds per capita for population of 70,280.

The investigations were made to secure the pounds per capita of rubbish and garbage to be disposed of and the variations therein. These are given in the following tabulation:

	Rubbish	Garbage	Totals
Annual average	2.24 lbs.	0.63 lbs.	2.87 lbs.
Summer collections	2.11 "	0.80 "	2.91 "
Winter collections	2.74 "	0.56 "	3.30 "
Peak days	3.20 "	0.85 "	4.05 "

4.3 RESULTS OF UPPER DARBY INVESTIGATIONS

In Upper Darby refuse collection is a municipal function. Accurate quantities of refuse collected, giving variations in its amounts, were not readily available. The figures were therefore interpolated to secure the information necessary to determine the total amounts collected and the variations therein. Rubbish is collected five (5) days per week and garbage six (6) days per week.

The amounts of rubbish collected were interpolated to be as follows:

Summer (July, August and September

Monday	130	
Tuesday	115	
Wednesday	120	
Thursday	130	
Friday	115	
Total per week	610	tons
Average per day	122	"
Peak day	130	"

Winter (October through June)

Monday	165	
Tuesday	135	
Wednesday	145	
Thursday	165	
Friday	135	
Total per week	745	tons
Average per day	149	"
Peak day	165	"

Based on the foregoing quantities the total amount of rubbish collected per year would be as follows:

Summer collections 13 weeks @ 610 tons	7,930 tons
Winter collections 39 weeks @ 745 tons	29,055 "
Total per year	36,985 tons

The operation of the incinerator plant is based on the burning of the refuse 300 days per year. On this basis the average tons per day and the per capita amounts would be as follows:

Tons per day	123.3
Pounds per capita per day	2.73

The amounts of garbage collected average as follows:

Summer (May through September)

Monday	26.7 tons
Tuesday	20.0 "
Wednesday	26.7 "
Thursday	26.7 "
Friday	26.7 "
Saturday	20.0 "
Total per week	146.8 "
Average per day	24.4 "
Maximum day	26.7 "

Winter (October through April)

Monday	21.4 tons
Tuesday	16.0 "
Wednesday	21.4 "
Thursday	21.4 "
Friday	21.4 "
Saturday	16.0 "
Total per week	117.6 "
Average per day	19.6 "
Maximum day	21.4 "

Based on the foregoing quantities the amount of garbage collected per year would be as follows:

Summer collections 18 weeks at 146.8 tons	2,642 tons
Winter collections 34 weeks at 117.6 tons	3,998 "
Total per year	6,640 tons

With 300 incinerator plant operating days the average tons and the per capita amounts are as follows:

Tons per day	22.13
Pounds per capita per day	0.49

The totals of the foregoing averages are as follows:

	Tons per day	Pounds per capita
Rubbish	123.30	2.71
Garbage	22.13	.41
Totals	145.43	3.12

The variations between summer and winter collections would be about as follows:

		Tons per day	Pounds per capita per day	Per cent
Summer -	Rubbish	122.0	2.67	82.9
	Garbage	24.4	0.53	17.1
	Total	146.4	3.20	100.0
Winter -	Rubbish	149.0	3.27	88.0
	Garbage	19.6	0.43	12.0
	Total	168.6	3.70	100.0

Peak day collections of rubbish and garbage are as follows:

	Summer	Winter
Rubbish	130.0	165.0
Garbage	26.7	21.4
Totals	156.7	186.4
Pounds per cap. per day	3.43	4.05

The variations in the amount of refuse to be disposed of are given in the following tabulation:

	Rubbish	Garbage	Total
Annual average	2.73	0.49	3.22
Summer Collections	2.67	0.53	3.20
Winter collections	3.27	0.43	3.70
Peak days	3.61	0.59	4.20

4.4 COMPARATIVE QUANTITIES

Investigations were made of the quantities of refuse as collected in other cities. A study by the United States Public Health Service for average collecting service gave the following pounds per day per capita:

	Summer		Winter	
	Min.	Max.	Min.	Max.
Garbage	0.30	2.3	0.2	1.2
Rubbish	0.60	1.8	0.4	1.1
Ashes	0.12	0.2	1.9	3.2
Combined	1.20	3.4	2.1	5.5

New York City designing its incinerator plants used the following average per capita weights:

Garbage and rubbish	2.33 lbs.
Coal and Ashes	0.37 "
Sweepings and litter	0.11 "
Total	2.81 lbs.
Maximum monthly	120 % of above
Minimum monthly	85 % of above

Figures of Los Angeles County gave an average of 2.7 pounds per capita per day. Others per capita per day amounts of refuse are as follows:

Winnipeg, Canada	(1947)	560 lbs. per capita per year
Louisville, Ky.	(1947)	2.23 lbs. " " " day
Philadelphia, Pa.	(1955)	3.25 lbs. " " " "

4.5 PER CAPITA AMOUNTS FOR DELAWARE COUNTY

Investigations of the amount of refuse collected in Chester and Upper Darby indicates average annual per capita amounts of 2.87 pounds and 3.20 pounds, respectively, but there are many par[illegible] of the county where these amounts would be considerably less.

A careful consideration of the data collected, together with spot checks of other county areas and comparisons of refuse amounts in other cities indicates that the per capita amounts of refuse to be disposed of in a 300 day collecting and incinerator operating year would be about as follows:

	Pounds per Capita	Per cent
Average annual	2.60	100
Maximum month	3.00	115
Maximum day	3.22	123
Minimum month	2.20	84
Minimum day	1.90	73

The annual production of refuse would be 300 times 2.60 pounds per capita per day, or 780 pounds per year per capita.

4.6 TOTAL AMOUNTS TO BE COLLECTED

Based on an annual average of 800 pounds per capita per year the tons of refuse that would be collected in the entire county for each of the listed years would be about as given in the following tabulation:

	1955	1960	1970	1980
Aldan Borough	1,656	1,760	1,916	1,960
Aston Township	2,696	3,340	4.400	5,600
Bethel Township	680	928	1,440	2,000
Birmingham Township	368	720	1,340	2,000
Brookhaven Borough	1,212	1,640	2,400	3,200
City of Chester	28,112	29,400	30,600	31,200
Chester Township	1,632	2,500	4,540	4,800
Chester Heights Borough	196	280	900	1,200
Clifton Heights Borough	3,216	3,360	3,560	3,600
Collingdale Borough	4,000	4,280	4,360	4,400
Colwyn Borough	880	920	984	1,080
Concord Township	920	1,280	2,400	2,800
Darby Borough	5,648	5,840	5,920	6,000
Darby Township	3,996	4,760	5,440	5,600
East Lansdowne Borough	1,444	1,480	1,504	1,520
Eddystone Borough	1,292	1,360	1,440	1,520

	1955	1960	1970	1980
Edgemont Township	512	840	1,400	2,000
Folcroft Borough	1,772	2,280	2,920	3,200
Glenolden Borough	2,964	3,200	3,340	3,360
Haverford Township	19,784	22,000	25,600	27,200
Lansdowne Borough	5,176	5,440	5,600	5,640
Lower Chichester Township	1,340	1,580	2,064	2,800
Marcus Hook Borough	1,548	1,548	1,580	1,600
Marple Township	4,472	6,240	8,800	11,000
Media Borough	2,500	2,720	2,800	2,880
Middletown Township	2,856	3,400	6,740	8,000
Millbourne Borough	360	364	370	376
Morton Borough	720	760	780	800
Nether Providence Township	3,288	5,000	6,120	6,400
Newtown Township	2,516	4,320	7,440	8,000
Norwood Borough	2,264	2,336	2,368	2,400
Parkside Borough	832	892	920	940
Prospect Park Borough	2,592	2,800	3,000	3,040
Radnor Township	7,348	8,800	11,280	12,000
Ridley Township	10,720	12,000	12,560	12,800
Ridley Park Borough	2,632	2,960	3,104	3,120
Rose Valley Borough	224	248	396	460
Rutledge Borough	380	384	392	400
Sharon Hill Borough	2,600	2,800	3,000	3,080
Springfield Township	8,660	10,160	11,520	12,000
Swarthmore Borough	2,332	2,448	2,500	2,520
Thornbury Township	948	1,100	1,720	2,400
Tinicum Township	2,320	2,360	2,540	2,560
Trainer Borough	832	880	1,040	1,140
Upland Borough	1,936	2,080	2,400	2,560
Upper Chichester Township	3,096	3,620	7,200	8,400
Upper Darby Township	36,512	37,720	39,200	40,000
Upper Providence Township	1,992	2,472	4,360	4,800
Yeadon Borough	4,588	4,580	4,840	4,880
Totals - Tons	200,564	224,180	263,038	281,236

CHAPTER 5

METHODS OF REFUSE DISPOSAL

5.1 DISCUSSION OF METHODS

It is not proposed to give a complete discourse on each method of refuse disposal, but rather to briefly describe each method in terms of what the method is and its applicability to disposal conditions as applied to Delaware County.

The following methods are discussed in this chapter.

1 - Garbage Reduction
2 - Composting of Garbage
3 - Garbage Grinding:
   a. Houshold Grinders
   b. Grinding Stations
4 - Landfill Disposal
5 - Incineration of Refuse

It is to be noted that the first three methods cover only the disposal of garbage, which today is only some 25 to 30 percent of the total refuse produced. This means that with the use of either of these methods all refuse, with the exception of garbage, must be otherwise disposed of. Incineration or burning would be the most likely method of disposing of this type of refuse.

5.2 GARBAGE REDUCTION PLANTS

5.2.1 Where Used

Many years ago garbage was the largest constituent of the refuse materials, being from 65 to 80 percent of the total. Ashes were collected separately in the larger cities and hauled to dumps. Where garbage was reduced the rubbish was hauled with the ashes to city dumps. At that time the amount of rubbish was negligible an compared with the amounts produced today. Reduction was, therefore a revenue producing method of garbage disposal.

Among the larger garbage reduction plants were the following:

New York, N. Y.
Chicago, Ill.
Los Angeles, Calif.
Columbus, Ohio
Indianapolis, Ind.
St. Louis, Mo.
Philadelphia, Pa.
Reading, Pa.

Most of these plants have been abandoned in favor of other methods of refuse disposal.

5.2.2 Description of Method

Briefly the method of garbage reduction as installed at Barren Island consisted of cooking the garbage to separate the grease from the solids in so called digesters. After cooking, it was discharged to pans below the digesters from which it was passed through roller presses. The water and free grease then flowed to a grease separating tank from which the grease was skimmed and the liquid or water flowed to a sewer. The solids from the presses was fed into dryers to evaporate the liquid contained in the pressed garbage. The dried material was then delivered to extractors wherein the grease left in the dried garbage was extracted by means of a solvent. After the final grease extraction the material was passed to secondary driers. The final dried material was then conveyed to a tankage storage building for final shipment. The operation of other garbage reduction plants were somewhat similar to the Barren Island plant, except that some of the plants did not use a solvent for final grease extraction.

The dried material was sold and used for feed and fertilizer and the grease was sold for various processing purposes. The plants created nuisance conditions due to the escape of digester and cooker gases and gases from the apparatus and dryers.

5 2.3 Present Status

With comparatively large per capita amounts of garbage the process was economical when the sale price of tankage and grease was high. Much of the time the prices of these were low and per capita operating costs were high. This together with the nuisances created by plants, led to their gradual abandonment and to the use of other methods of garbage disposal.

With the present low per capita production of garbage the process would not be economically feasible for Delaware County. In addition to the disposal of garbage, constituting some 20 to 25 percent of the total refuse to be disposed of, other means would have to be provided for the disposal of the rubbish.

5.3 COMPOSTING OF GARBAGE

5.3.1 Not a New Process

Composting is not new. For centuries farmers have piled manure and other barnyard wastes in heaps to produce, months later, a humus like material with fertilizer properties and in many parts of the world farm composting plays an important role in agriculture, Composting municipal garbage has long been practiced in Europe. Poor natural resources and intensive farming operations have led to a search in these areas for fertilizers produced by composting of organic waste to take the place of the more expensive inorganic chemical fertilizers.

In the United States, soil conservation and rebuilding through the use of organic fertilizers has not assumed a great role in agriculture because the organic fertilizers produced by composting must compete with cheap inorganic fertilizers. At the present time more is known about the bio-chemical processes that enter into composting than about operating costs under commercial operations.

Several large scale experimental plants have been built for the composting of garbage and glowing reports have been made of the results secured. Wherever the process has been considered for municipal operation the costs have been too high to warrant its use, particularly as other means must be used for the disposal of the rubbish.

5.3.2 BASIC STEPS IN COMPOSTING

The fundamental steps for aerobic composting include (a) removal of noncompostables, (b) grinding, (c) moving and placing for composting, (d) turning or aerating, (e) regrinding and bagging or storing in bulk for sale.

Removal of non-compostables must be undertaken to permit efficient grinding. Tin cans, and glass are the most objectionabl If separate collections could be enforced the segregation of compostables would be a simple matter. From a practical viewpoint, composting operations must be based upon the assumption of mixed refuse arriving at the compost plant. To mechanize the removal procedure, a conveyor belt with magnetic sorter for ferrous metals should be provided. Hand picking of non-combustibles from the conveyor belt will remove glass and other objectionable items. Hand picking of rags for salvage may be profitable and paper can also be salvaged if desired. Blower arrangements have been used to remove excess paper from the conveyor belt for salvage purposes. Tests of the amount of compostables remaining after initial segregation from a study of a number of California cities indicates that approximately 66% of municipal garbage can be composted.

The second basic step necessary for good composting is grinding of the raw refuse. The development of efficient grinders which can handle the abrasive American refuse and render it fit for composting is one of the problems which must be solved to make this method of waste disposal economical and practical. Grinding is important because it makes the raw material susceptibel to bacterial decomposition.

Care must be taken during the grinding operations to prevent the raw material from becoming too soggy to compost. For rapid composting of municipal refuse a moisture content between 40 and 65% has been found to be most desirable. If moisture content is too high, additives such as straw, paper, soil or sawdust must be added during the grinding operations.

After grinding operation, the raw material must be stacked or piled for aerobic decomposition. Various cells or digesters have been developed in which decomposition may proceed, usually with the addition of air to keep the process aerobic. To keep cost down, open air composting can be practiced in many parts of the United States where the amount of rainfall is low and ground temperatures are high.

5.3.3 Current Status of Composting

Compost Corporation of American Operation at Oakland, Calif

The Oakland plant was the first large scale, commercial, open-air operation in the United States. Started in 1950, operations were suspended in 1952, pending a redesign of buildings and machinery. To date, composting has not been resumed.

Frazer Operation at Mt. Wolf, Pennsylvania.

Process and mechanical difficulties forced the abandonment of this digester-type of plant.

Frazer Operation at Bayshore, Long Island.

Operations in the digester were unsuccessful. Instead of 10 tons per day as predicted, compost production averaged only 3 to 3-1/2 tons per week. Faulty design of the digester plus mechanical difficulties were blamed.

Frazer Operation at Chicago Stockyards.

Early operations of composting manure in a digester were abandoned and replaced by a combination open-air and digester process.

Organiculture, Inc. Operation at Miami, Florida.

This digester-type plant has been in operation for about a year and is still in the experimental and promotional stage. Only a small percentage of tree and brush trimmings collected by the city are utilized by the corporation.

In the year 1950 a process of composting or fermentation was proposed for Miami, Florida. Private interests proposed to finance the construction of a 900 ton plant at a cost of $2,400,000. The process was proposed by Verdier and was based on the plant constructed at Cannes, France. After long and careful consideration it was decided not to accept the proposal. Since then Miami has decided to dispose of its refuse by incineration. One plant has been constructed and plans are being made for other plants.

Composting Operations of Growth, Inc., N.Y.,N.Y.

A pilot plant of the digester-type located on Staten Island has been reported a success. Backed by experience obtained from this operation, Growth, Inc., a non-profit organization, intends to enter into contract with municipal officials to build municipal composting plants, using bond issues to gain the initial capital. All profits are to go into an eductional fund.

5.3.4 Ventures Being Considered

Kansas City, Missouri

A proposal was made by Growth, Inc., to build a digester-type of composting plant for Kansas City. The plant was to cost $200,000 and handle 150 tons of garbage daily. Recent information, however, indicates that Kansas City is continuing hog feeding as a disposal method.

Hagerstown, Maryland

Early in 1952, officials of Hagerstown signed a contract with the Frazer interest for the construction of a composting plant like the one at Bayshore, Long Island. In April, 1953, they decided to cancel the contract after hearing about the Bayshore plant's difficulties.

Milwaukee, Wisconsin

In 1952, Milwaukee investigated the possibility of composting municipal refuse in open-air piles. It was estimated that a plant handling 100 tons of refuse per day would cost about $250,00(After careful consideration, the city decided that composting was not economically feasible.

University of California Research

The Sanitary Engineering Research Laboratories at Richmond, California, spent two years investigating the practice and fundamentals of open-air composting. Results of these studies show that: (a) for open-air composting in climates similar to that of the San Franscisco Bay Area, compost can be produced from municipal refuse in 12 to 21 days; (b) the addition of special innocula of bacteria or enzymes is unnecessary ; and (c) the greater technical problem currently associated with open-air composting is that of designing equipment suitable for grinding the mixed refuse and turning the composting pile.

Michigan State College Research

The Department of Civil and Sanitary Engineering has had a high-rate composting digester in operation for over a year. It is reported that garbage is converted by a continuous flow process into a stable compost in 2 to 3 days. Seeding is accomplished by recycling a portion of the end product. From a description of the process, it appears that raw garbage rather than refuse is employed as the raw material.

5.3.5 Composting for Delaware County

A careful consideration of all present factors indicates that composting is not applicable to the condition pertaining in Delaware County. Separate services would have to be provided for the collection of garbage constituting some 20 to 25 percent of the total refuse, and other means, such as incineration, would have to be provided for the disposal of rubbish.

5.4 GARBAGE GRINDING

5.4.1 GENERAL

The idea of grinding garbage for disposal with sewage is over 30 years old. In 1923, Fox and Davis introduced ground garbage into sewers leading to the sewage treatment plant of Lebanon, Pa. Keefer & Kranz by laboratory and field studies demonstrated that garbage could be ground, carried by city sewers and handled in the Baltimore, Md. sewage plant. In Durham, N.C., garbage was ground and discharged to the sewer system during peak waste periods associated with the watermelon season. At Indianapolis, Ind., a garbage grinding station discharged wastes into the sewage. At Schnectady, N.Y. garbage was discharged into the sewers in the early thirties.

There are three methods of dual disposal of garbage with sewage; (a) by installing household garbage grinders and discharging the ground material, mixed with water, into the sewer; (b) by installing central municipally operated stations for grinding garbage to which it is hauled and then ground and dumped into the sewer; and (c) by hauling garbage to the sewage treatment works, where it is ground and discharged either into the raw sewage or into the digestion tanks.

5.4.2 HOUSEHOLD GRINDERS

5.4.2.1 Use of Grinders

The installation of household grinders progressed slowly from their inception around 1921, and until the beginning of World War II only some 55,000 installations had been made. Since the end of that war, a number of manufacturers have offered household grinders, so that their use has become more general. Marketing records of the National Electrical Manufacturers' Association indicate that the total number of grinders installed in the United States was over 1,000,000 in 1951. Many installations have been made since then.

Universal adoption of grinders would be necessary if methods of collection and disposal of refuse are to be materially affected. In many cases, garbage may constitute only about 10 per cent of the total volume of refuse collected. As a very large proportion of the municipal refuse cost is in collection, the removal of less than 10 per cent of the material to be collected will result in but little saving in collection costs. The cost of household grinders will probably keep many communities from being wholly equipped with them.

Although many large cities encourage the installation of household grinders, a number of them still prohibit their use. Some limit their disapproval to installations in hotels, restaurants, etc. In some cases, disapproval is due to apprehension that the existing sewage treatment plant will be overloaded. In others, the fear, entertained also by some states, is that there may be damage to the stream control program. In Indiana, cities operating sewage treatment works on a revenue bond basis are authorized to issue revenue bonds to finance the installation of kitchen garbage grinders, if adequate sewage treatment facilities exist.

As far as known, the Pennsylvania State Department of Heal does not prohibit the use of household grinders, provided the sewage treatment plants have sufficient capacity to properly treat the combined wastes. In Delaware County all sewage plants have been designed for the treatment of sewage only and not for the combined garbage and sewage solids. There are some installations of garbage grinders but the number is so small that the effects of garbage solids are not noticeable in the operation of the sewage treatment plants. To provide a county wide use of household grinders, or to include ground garbage from central garbage grinding stations, would require the making of considerable extensions to existing sewage treatment facilities. The three sewerage authorities operating in the County now prohibit the use of household garbage grinders.

5.4.2.2 Installations

Jasper, Ind. (population 5,200) attracted nation-wide attention in 1949 by its decision to dispose of all decayable food wastes from homes by kitchen garbage grinders. This decision made it the first community in the United States, and probably in the world to attempt city-wide installation of household garbage grinders. At present, over 900 grinders are in use, serving 75% of the community's population. As a result of this decision, plans for a sewage treatment plant for a design population of 10,500 (1975) were revised as follows:

	Without Garbage	Garbage and Sewage
Design Flow	1.0 M.G.D.	1.0 M.G.D.
Comminuter	One 15"	One 15"
Primary settling	2 units-1.55 hr. detention	2 units-1.55 hr. detention
Aeration Tanks	2 units-5.2 hr. detention	3 units 7.8 hr. detention
Final settling	2 units-2.6 hr. detention	2 units-2.6 hr. detention
Sludge Digestors	1 unit-4.2 cu.ft./cap.	2 units-6.6 cu.ft./cap.
Sludge Beds	4 units-1.9 sq.ft./cap.	8 beds-3.1 sq.ft./cap.

The Jasper sewage treatment plant is of activated sludge type As shown in the foregoing, the inclusion of garbage grinding caused about a 100 percent increase in the aeration tanks, a 200 percent increase in the sludge digestion tanks and a 300 percent increase in the sludge drying beds.

A joint study of the "Jasper Plan" covering the period from March 1950 to October 1951 was made by the Indiana State Board of Health and the U.S. Public Health Service. A summary of the findings is as follows:

1. No noticeable increase in water use.

2. No deleterious effect on the sewers (sizes 6" to 12"; velocities 1.75 to 6.8 ft. per sec.)

3. Organic load (B.O.D.) increased from 0.12 to 0.18 lb. per capita per day.

4. Organic load attributable to ground garbage has varied considerably in terms of sewage load.

5. Grease observed was 0.07 pounds per capita per day.

6. Peak B.O.D. loadings from garbage were in the neighorhood of 250 percent of the average.

7. The concentration of volatile solids in the grit was arou 80% and the moisture content about 76%.

8. Average concentration (B.O.D.) of raw sewage ranged from 228 p.p.m. with 8% grinders to 410 p.p.m. with 72% grind

9. Suspended solids removal by primary tanks averaged about 70%.

10. When no waste-activated sludge was present, raw sludge concentration averaged 5.8% with volatile solids content of 72%; with such sludge, the concentration dropped to 3.5% with but little change in the volatile content.

11. Results of secondary treatment were erratic because of the usual operational difficulties when breaking in a new sewage treatment plant.

12. Indications were that the number of flies were reduced, due to the improved garbage-handling practices.

13. The rodent population also appeared to be reduced.

Los Angeles, California

About one family in eight in Los Angeles (population 2,000,000) has kitchen food-waste disposers in operation, a total of roughly 80,000 grinders. The increasing use of grinders has resulted in a steadily reducing quantity of garbage collected by city forces, which dropped from 0.65 pound per capita per day in 1946-47 to 0.48 in 1951-52.

Until very recently there has been no evidence of the ground garbage in the sewer system. However, the need for maintenance increased in the upper terminus of a sewer built on a relatively flat grade and serving a number of apartment houses, as heavier particles settled out and clung to the side of the sewer, causing odors. Also, a heavier blanket of scum was observed in the wet wells of the pumping plants, caused by garbage floating on the sewage. The ground food wastes have not presented any problems in the sewage treatment plant.

There were 31,000 new disposers installed in 1952 and 45,000 are expected to go in during 1953. The City looks with favor on this increased use of grinders because of their reduction of fly and rodent lazards, odor nuisances, etc. and because of the useful by-products obtained from the treatment of the food wastes with the sewage at the sewage plant.

Cleveland, Ohio

Between 15,000 and 20,000 grinders are in operation in Cleveland (population 915,000), or one for every 15 households. About 2,000 are being installed each year. No substantial change in the character of the refuse collected could be attributed to th grinders. No sewer line has given any trouble because of the grinders; nor has any appreciable difficulty been experienced at the sewage treatment plant. The City strongly favors the adoption of grinders as a step toward cleaner household conditions, less garbage to be collected by the City forces, and less of a load on the municipal incinerator.

Oklahoma City, Oklahoma

There are about 4,000 grinders in use in Oklahoma City (population 224,000), or one per 15 families. They are being installed at the rate of 300 per year. The City ordinance provide for the installation of domestic grinders in single-family houses only. No difference has been observed in the amount of garbage collected (which is fed to hogs), in the functioning of the sewer lines, nor in the operation of the sewage treatment plant.

Detroit, Michigan

In Detroit (population 1,850,000) there are about 20,000 domestic grinders, or one for every 23 families. More are being installed at the rate of about 2,500 per year. There has been no measureable decrease in the quantity of refuse collected (garbage and rubbish are collected together). No trouble has been experienced with the sewer lines because of the grinders. The City favors the increased use of the food-waste disposors, to reduce or eliminate City garbage collection and incineration, even though it will increase the need for more sludge disposal and chlorination facilities at the sewage treatment plant.

Indianapolis, Indiana

With a population of 427,000, Indianapolis has about 4,500 kitchen garbage grinders, or one per 24 families. Installations are going in at the rate of 500 to 1,000 per year. No trouble has been experienced in the sewer system, nor has the volume of sludge increased at the sewage treatment plant because of these grinders.

Minneapolis, Minnesota

Minneapolis (population 522,000) has approximately 5,000 kitchen grinders in service (roughly 1 for every 26 families) and about 1,000 more units are being installed yearly. While the volume of refuse collected has remained about the same, its weight has dropped from 230 to 225 tons daily. No difficulty has been experienced with the sewerage system.

Washington, D.C.

Washington (population 800,000) has about 6,000 grinders, one for each 30 families. About 1,000 units are being installed annually. The City also operates a 10-ton garbage grinder, from which ground garbage is sent to the treatment plant.

Philadelphia, Pennsylvania

Upon completion of its Northeast sewage treatment works in 1951, Philadelphia (population 2,000,000) lifted its ban on kitchen garbage grinders in the area served by the plant. Prior thereto the dumping of deleterious matters into the sewers was prohibited by an 85-year old ordinance.

Shorewood Hills, Wisconsin

The Village of Shorewood Hills, Wisconsin, is essentiall a small residential community of about 475 homes occupied by appr imately 1,700 people. When public health officials refused to per mit the dumping of garbage or the feeding of same to hogs on land under their jurisdiction, the Village was forced to haul its garb to a farm 35 miles away. Both sanitary landfill and incineration being prohibitive in cost, garbage grinding was thoroughly investigated as to experience elsewhere, effect on sewers, sanitary benefits, reliability, cost and method of financing. As a result the Village awarded a contract for the installation of domestic garbage grinders in all homes.

5.4.2.3 Effect on Sewers and Treatment Plants

Experience at Jasper, Indiana, indicates that a municipality can satisfactorily dispose of garbage with home grinders provided: (1) its sewers conform with the accepted standards for sanitary sewers; (2) its sewage treatment facilities are adequate or provisions for expansion are provided; and (3) its population is progressive and financially able to support any type of garbage disposal facilities.

On the basis of 3 months' experimental research with household garbage grinders at Detroit, Michigan, the following conclusions were reached as to the effects of the introduction of ground garbage into a sewer system:

1. On the average, 25 percent of the dry solids will go into solution or non-settleable suspension in the grinding process.

2. Limitations on acceptable garbage grinder operation shoul specify that not more than 30 percent, on the dry basis, shall pass a No. 40 U.S. Standard sieve. If it is assume that 100 percent of a community's garbage is ground and introduced into the sewer system for disposal at the sewage treatment plant, the following conclusions could also be reached:

3. The chlorine demand of the effluent of the primary sedimentation process may be increased 0.12 p.p.m., or about 4 percent, as a maximum.

4. The average increase in B.O.D. of primary effluent would be from 20 to 25 percent.

5. The increase in solids to be handled at a primary plant, would average about 50 percent.

5.4.2.4 Trend

While the trend is toward an increasing number of home garbage grinder installations, a recent study in the East Bay area at San Francisco, California, indicates that only 30% will be installed by 1970 and 70% by the year 2000. If this is true, the effect of food wastes from this source will generally be of minor importance at sewage works for the next 25 years.

If the use of garbage disposers follows the sales pattern of most other household appliances, it will be more than 20 years before half the dwellings in the average community will be so equipped.

A dozen or more manufacturers and distributing companies are marketing household garbage grinders. Over 500,000 units are in use in 350 or more communities in the United States. Many unit are operating on septic tanks of private sewage disposal systems.

A trend toward the use of commercial units in communities is indicated by the recent Dearborn, Michigan ordinance requiring their use in all new buildings, except 1 to 4 family residences, and in all buildings remodelled and used for storing and preparing various types of foodstuffs for human consumption.

5.4.3 CENTRAL GRINDING STATIONS

5.4.3.1 Design of Stations

Grinding stations can be of very simple design, with manual feed, where small tonnages are ground, or quite elaborate, with mechanical feed, where large tonnages are expected. They can be located at the sewage treatment plant or at strategic points on the sewer system. If located at the plant, the ground garbage can be added to the raw sewage entering the plant or it can be added directly to the digesters. Properly designed, such stations [illegible] go far toward satisfactorily handling the garbage grinding and grit removal operations, while provision of adequate digester capacity should solve that phase of the problem.

Garbage grinding stations need not be objectionable. Exterior architecture should harmonize with the neighborhood, grounds should be landscaped to present a pleasing appearance, and doors and windows should be tight. Garbage should be dumped and ground only when doors and windows are closed. Fans should constantly exhaust the inside of the building and the air should be put through activated carbon containers, ozone, or other means of purifying the air.

Grinding stations can be located at any number of points, the number used being dependant on the amount of garbage that is to be ground and the costs of hauling the garbage to the individua stations.

5.4.3.2 Installations

Findlay, Ohio

The sewage plant at Findlay, Ohio is designed for a population of 35,000. In 1938, secondary treatment by activated slud was added to the original sedimentation tanks with separate sludge digestion and sand drying beds. At the same time a garbage grinde was installed but the capacity of the sludge treatment facilities was left unchanged. Garbage, sprinkled with lime for odor and pH control, is ground usually once on the day shift and once on the night shift, each operation taking 15 to 30 minutes. It is introduced into the sewage ahead of the detritor.

Marion, Indiana

At Marion, Indiana, (40,000 people) garbage was added directly to the raw sewage entering the activated sludge plant fro June 1941 to May 1943. Then a garbage pit with an effective capacity of about 4,000 gallons was formed by partitioning off a portion of the wet well in the sewage pumping station. It can store about 4 tons of green garbage with a 5% solids content. Lime was added to the pit for pH control except when the garbage was prompt pumped to the digester. Operating records show the gallons of wast sludge per 100 p.p.m. of suspended solids to be about the same whether garbage solids are discharged to the primary tanks or directly to the digesters. The quantity of garbage was 0.8 tons per million gallons of sewage.

Goshen, New York

At Goshen, N. Y. garbage is ground at the sewage plant and sent directly to the primary sludge digestion tank. The plant was put into operation in 1940 and consists of primary settling tanks, two heated digesters, drying beds, and a sand filter for secondary treatment in the summer months. For the population of 3,000 and average flow of sewage of 450,000 gallons per day, the digester capacity was 4.3 cu.ft. per capita and the garbage averag 0.51 lb. per capita per day, or 1.6 tons per m.g. of sewage. Groun garbage excluding so-called garbage grit (bottle tops, glass, bones etc.) is blown by an ejector directly to the primary digester. Between the primary and secondary digesters is a manhole at which, when necessary, larger inorganic solids can be removed before the sludge is ejected to the secondary digester.

Lansing, Michigan

At Lansing, Michigan, all garbage is ground at the sewag plant and, after removal of grit in aerated holding pits, is sent to the heated digesters of the sewage plant, which is of the standard activated sludge type, designed for a population of 80,000 in 1938. The digested sludge is dewatered on vacuum filters and then incinerated. Additions to the plant in 1950 because of serious overloading raised its capacity from 9.2 m.g.d. to 20 m.g.d. from a population of 125,000. Digester capacity was increased from 3.7 to 11.0 cu.ft. per capita. Green garbage amounted to 0.66 lb. per capita per day, having solids amounting to 17.5% with a volatile content (on a dry basis) of 88.4%. It is dumped on the floor and fed manually to a grinder after the heavier non-organic matter is picked out. The ground pulp is blown directly to the digesters.

Richmond, Indiana

Richmond, Indiana has been grinding its garbage and pumping it into the digesters of its sewage treatment plant since the Spring of 1951. This plan was adopted in connection with an enlargement of the sewage treatment plant because: (1) separate collection of garbage was an established practice; (2) sites for landfill disposal were difficult to find and expensive; (3) equipment for grinding sewage screenings was in use; and (4) the additional gas would be useful for operating the activated sludge plant. Digester capacity of 10 cu.ft. per capita was provided for combined sewage sludge and garbage.

5.4.3.3 Effect on Sewers and Treatment Plants

As to the effect of ground garbage on the sewer system, there need be no fear of stoppage occuring from this material. Combined sewers are designed for minimum velocities of approximately 3 feet per second, and since the grinding stations would be located only on the larger sewers, the velocities and the volume of flow would be sufficient to prevent stranding of solids. Garbage grit, amounting to approximately 40 lb. per ton of garbage, must be waterborne to the treatment plant, but since the size of particles will be smaller and their specific gravity lower than the largest and heaviest particles of sand and gravel now carried by sewers, there should be no undue alarm because of the addition of a smaller amount of lighter and more easily transportable garbage grit. Garbage grit will probably not exceed 1.0 cu.ft. per m.g. where garbage is added to the sewage at a rate of 1.0 ton per m.g.

It appears on first thought that garbage would add a very heavy load to that which the sewage plant must treat, but every sewage plant always receives a considerable amount of waste from domestic preparation of food. Besides juices, any solids fine enough to pass the sink strainer are flushed into the sewer. In any case, the additional load (from household grinders) need cause the sewage plant operator no alarm. Any calculations of solid loa ings, either garbage or sewage, or both, should be made on a comparable basis of either total solids or suspended solids.

The increase in strength of raw sewage from garbage is dependent upon the pounds added and the nature of the garbage solids. The average annual quantity of garbage is normally 0.5 pound per capita per day. The quantity varies, of course, with the season and may be only one-half of this figure during the wint months and twice this average during the late summer and early fal The total solids in green garbage varies from 15 to 30% and are partly in suspension and partly in solution, the suspended solids including some grit which the sewage plant grit chamber could remc The greater the distance from the plant that garbage is ground, tl less will be suspended solids arriving at the plant, due to leaching out of soluble garbage solids by the flowing sewage.

In a comprehensive discussion of the subject of ground garbage, Tolman, who made an extensive study of garbage grinding, ends with the following conclusions and recommendations, where garbage is added to sewage at an average **daily** rate of 2 tons per million gallons of sewage:

1. Facilities should be provided for removal of garbage grit before this material is sent to the digesters.

2. When garbage is added to the raw sewage, the increase in suspended solids will be approximately 25 to 35 per cent and in B.O.D. 18 to 26 per cent, depending upon the solids in the raw garbage.

3. The strength of primary settled sewage after 2.0 hours settling will be increased approximately 10 to 14% suspended solids and 11 to 16 per cent in B.O.D.

4. Garbage matter is oxidized by activated sludge and probably by all secondary processes as efficiently as is sewage material; therefore, increased plant secondary units must be based upon the increased garbage load in the primary effluent.

5. For digestion of primary solids and garbage, 5 cu.ft. per capita of digester capacity is needed.

6. The most economical means of dual disposal appears to be by direct addition of garbage to the digesters, unless central grinding stations are used.

5.4.4 SEWAGE GRINDING IN DELAWARE COUNTY

5.4.4.1 Present Use

The addition of ground garbage to sewage either from household grinders or from central grinding stations is now prohibited by officials having charge of sewage treatment plants in Delaware County. In the future, and with the provision of additional sewage treatment plant facilities, the ban on including ground garbage in the sewer system will be probably be lifted. This will be due in a large part to the increasing popularity of this method of garbage disposal.

5.4.4.2 Disposal of Other Refuse

The disposal of garbage by household grinder or central garbage stations covers only one phase of the problem of refuse disposal. As previously stated the garbage constituent of municipa refuse now averages between 20 and 25 per cent of the total amount to be disposed of and in the future may be less. The remaining 75 to 80 percent of the refuse must therefore be disposed of otherwise. Consisting largely of combustible matter it should be disposed of by incineration. With this manner of refuse disposal the increased cost of the incinerator facilities to be provided will of course be greater than for the incineration of rubbish alone, but not in a direct ratio to the increase in amounts caused by the inclusion of garbage for incineration.

5.4.4.3 Effect on Incinerator Plants

Should the use of household garbage grinders be allowed in Delaware County, as in all probability it eventually will, the effect will be to increase the capacity life of the incinerator plants. The capacity provided for the refuse incinerator plants covers the inclusion of garbage and the elimination of garbage will reduce the amounts to be incinerated. Based on the experiences in other cities that have allowed the use of household grinders for garbage disposal, it will however, be many years before the effect of this is felt in the refuse disposal facilities.

5.4.4.4. Recommendations for Delaware County

Inasmuch as the use of household grinder or central garbage grinding plants are now prohibited by most municipalities in Delaware County, these facilities cannot be considered for the county disposal of municipal refuse.

5.5 DISPOSAL OF REFUSE BY LANDFILL

5.5.1 USE OF METHOD

Engineers in the field of Public Health can approve either sanitary landfill or incineration of municipal refuse. A considerable part of the garbage produced in the county is fed to hogs either in the county or in nearby points. Thus while the county has taken elaborate steps to protect the people from the results of the pollution of waters by sewage, steps have not been taken to preserve the safeguards to prevent the spread of trichinosis infections caused by the feeding of raw garbage to hogs. The next two sections of this chapter will therefore discuss the use of these methods for refuse disposal.

5.5.2 THE LANDFILL METHOD

Sanitary fill, known as "cut and cover" in this country and "controlled tipping" in England, was developed to overcome the many obvious shortcomings of the unsanitary open dump. Essentially it consists of dumping a mixture of garbage, rubbish and ashes into a depression or trench, compacting it and promptly covering it with a layer of earth. The earth cover excludes rodents and other vermin, prevents the escape of odors and largely prevents fire.

During the past decade the use of the landfill method has spread widely. Reports indicate that there are more than 500 sanitary landfills in the United States. Refuse disposal by this method is a two-in-one procedure, a single operation serving to store and dispose of the refuse.

Acceptance of the sanitary landfill by the general public is far from general as the terms landfill, dump and sanitary fill are more or less synonymous. Where it is properly operated and proper controls are maintained, it generally meets the public health criteria. Garbage should be wrapped by the householder and it and the rubbish, etc. should be promptly placed in the fill operation so as to control the production of odors generally caused by the decaying organic matter in garbage.

Sanitary landfills are of two principal types- the area-fill and the trench-fill, sometimes called "fill and cover" and "cut and cover". The nature of the land available generally governs the choice of type, although the availability of cover material may be a factor. Area-fill involves the fill in of low lying land, abandoned quarries, canyons, hillsides, etc., with a series of cells consisting of refuse surrounded by earth.

The trench-fill is probably the simplest and least expensive method of operating a sanitary landfill. Ordinarily a trench 2, 3, or 4 feet in depth is cut in relatively level land in order to obtain material with which to cover the refuse later deposited in the trench.

A main essential to these operations is the adoption of methods that will assure sanitary conditions. Of primary importance is that the fill be completely covered at the end of each working day. A further requirements is that the top covering be approximately two feet or more in depth in order to assure complete control of rodents and flies. It is not necessary that a covering...

of this depth be made each night, but it is important that such a covering be provided before operations are moved to an adjoining area. Such a covering assists in the control of odor, prevents the escape of obnoxious gases, and is helpful in the prevention of fires within the fill.

Its use is warranted where adequate areas are available and proper for the use of landfill operations. There are probably fewer difficulties to overcome if the soil available for cover is a sandy loam. Where used in swampy or tidal lowlands, extra precautions must be taken to assure its proper operation and to prevent pollution of nearby waters.

5.5.3 LANDFILL OPERATIONS

As reported by the Committee on Refuse Collection and Disposal of the American Society of Civil Engineers, landfill operations have been used as given in the following discussion.

The City of New York has created thousands of acres of useful land of filling in low lying areas and marsh lands with refuse. Four sites are in use at the present time and the City's new policy is to fill only property owned by the City. Landfill operations will, however, be discontinued when the City's incinerator program is completed.

In general, the method of operation is to prepare the site by filling with sand or dirt or other innocuous material to a level above tidal action and to enclose the area with a dike to prevent leaching out obnoxious material. The cover, consisting either of sand or dirt, is then stockpiled. The operations are conducted in rather narrow strips in the following manner; material is dumped along the edge from the trucks and then is bulldozed down the bank. Scrapers bring material for covering the open face and at the end of each day's operation the refuse is completely enclosed. The sand cover is approximately two feet thick and both the cover and refuse are fairly well compacted by the travel of the heavy equipment across the surface. In addition, a tank truck equipped with spraying device continually sprays the open face with deodorants.

The North Side fill in St. Louis is another example of a sanitary fill used successfully by a large city, although it is too limited in extent to serve as other than a temporary device. Rubbish collected in the north half of the city is disposed of on 85 acres of low land. Some 37 acres have been filled to an average depth of 17 feet in four years of operation. Although the site is typical of an area fill operation, it is necessary to excavate a trench of sufficient depth to get necessary cover material. A 2-1/2 cubic yard drag-line is used to dig the trench and stockpile cover dirt on top of the completed fill. After dumped material is burned, about a foot of dirt is pushed over it by means of a bulldozer. This amount of cover has been found satisfactory inasmuch as there is no garbage or other readily putrescible matter in the refuse. The fill is brought up in two lifts of about 8 feet each. No specific effort at compaction is made but some results from the dozer running over each lift as the fill is constructed, and from two 15 cubic yard, trucks running over the fill and backing up to dump.

The City of Baltimore reports experience with both sanitary trench-fills and area-fills. Mixed refuse is dumped, and spread in a layer about 6 feet thick by a bulldozer. When cover material becomes available it is placed on top of the refuse to a depth of 9 to 12 inches. Successive 6 foot layers of refuse are added until the fill surface has reached the desired final grade. The weight of delivery equipment provides the only compaction that is obtained in the process.

The Sanitary Landfill in Baltimore is operated as a trench-fill. Refuse material is dumped by the collection vehicles at a distance of from 10 to 15 feet from the edge of the dumping face. A 22 ton bulldozer pushes the waste over the edge of the dumping face, and in this process the operator raises the blade, thereby permitting the full weight of the equipment to be applied at the edge of the fill. This is a continuous process throughout the eight-hour working day. The materials coming to the disposal site are proportioned so that a combination of 50 per cent garbage and ashes, and 50 per cent rubbish and street dirt goes into the fill. A 40 ton crane equipped with a 1-1/2 cubic yard drag line bucket operates along the top of the fill at the edge of the cell that was completed on the previous day. It operates continuously during the working day digging cover material from the surface of the area to be filled on the following day and stockpiling it until needed.

When the filling has proceeded to any desired point a 6 inch prime cover is spread to prevent the blowing about of debris as well as to cover the unsightliness of the placed refuse. Where-ever it is found necessary, particularly in not dry periods, a strong disinfectant, having a creosote base, is liberally sprayed over the waste and on the site of operations generally. The dust is laid by frequent spraying of water by 1,000 gallon tank flushe: On occasion, calcium chloride has been used in connection with the water. At the close of the day's filling, a final 2 foot cover is placed by the bulldozer over the top of the compacted fill. The crane then moves onto the cell and helps spread the cover, in addition to shaping the front slope by crushing bulky boxes and barrels and further compacting the fill under its weight. A light coat of cover material is applied to the slope by the crane. Thus, at the conclusion of each day's operation, both the top and the slope are completely covered.

At Winnetka, Illinois an operating procedure for a trench-fill has been worked out which has a number of advantages. The fill from the bottom of the trench to a final elevation some 5 feet above the original ground surface is made in two lifts. The first lift brings the refuse fill up to the original ground surface where it is covered with about 6 inches of earth, cinders, or other dry material stockpiled for the purpose. The first lift is started from a permanent access road which forms one end of all the trenches and as work progresses, the trucks are backed in over the new fill with its light cover to reach the dumping point. The second lift is started from the far end and progresses back to the access road, being covered by dirt excavated from the next trench.

The temporary cover over the first lift is sufficient to prevent odors during the two week period that it is in use, and the continued traffic over it compacts it so that no rat trouble has developed. The only disadvantage, which might limit the method on large operations, is that only one truck can be dumping at a time since two cannot pass on the narrow filled trench if the adjacent soil is muddy.

San Francisco has been using a sanitary area-fill ever since the legal closing of an incinerator a number of years ago. The fill is operated by two private companies which cooperate in the work. Refuse is brought out in gondola cars, dumped on mud flats, and covered on the top and face with soil and rock quarried nearby by use of explosives and normal quarry equipment. Little effort is made to compact the fill. Plastic flow of the underlying mud takes place but the degree is unknown. There are no rats about the operation although a few flies are in evidence. A tremendous number of sea gulls frequent the site. Opening of a section of the fill which had been in place for 12 years revealed that little decomposition of fruit and vegetables had taken place. Colors of vegetable material were intact until exposed to the air for a few minutes. Newspapers could be read and tin cans were bright, although some electrolysis had taken place. A temperature rise of from 6 to 8 degrees was observed in an 8 foot depth.

Many small and medium sized cities in California employ sanitary landfills. In 1950-1951 a study was made of 13 cities ranging in size from 5,500 to 244,000 population. Of particular interest is the city of Fresno which was one of the first cities in the United States to operate a landfill on flat ground by the trench-fill method. In this operation a crane is located at the toe of the fill slope where it is used to pull the load from diaphram type refuse trucks, to dig the trench for the next cell, and to cover the newly placed fill. It is also used for compacting the fill by dropping a 1-1/2 cubic yard bucket, loaded with earth being dug from the trench, upon the refuse from a height of about 10 feet. Other compaction is obtained by the refuse vehicles passing over the fill. This location of the crane is considered unorthodox by many who prefer to work from the top of the fill. Inasmuch as the Fresno fill increases some 30 feet from the bottom of a 12 foot trench to the top of a 3 to 4 foot cover, the crane is probably working to its best advantage from the mid-elevation at the intersection of the new fill and the original ground which is to be dug away to form a new trench.

5.5.4 DISPOSAL OF GARBAGE

A large percentage of the cities and communities using the method have found that they encounter no problem when garbage is included in the refuse being deposited in a sanitary landfill when regular, careful, and complete covering is provided. Where burning of combustible components of rubbish is a part of the method of operation, it is important that garbage be dumped in a section of the fill which is not to be ignited. The fact that garbage may be used in the sanitary landfill is increasing in importance, especially to those many communities where raw garbage is now being fed to hogs and where laws are being passed to stop such feeding because of vesicular exanthema. The thirteen cities surveyed in California all incorporate garbage into their sanitary landfills. Winnetka, Illinois does likewise. Of the larger cities discussed in this report, New York, Baltimore, and San Francisco place garbage in sanitary landfills. In Washington, D.C., garbage is fed to hogs, and St. Louis is grinding its garbage into the river.

Refuse containing household garbage in ordinary amounts will average about 100 pounds per cubic yard heavier than refuse which does not include garbage. In cities where land area for fills is extremely scarce, exclusion of garbage only serves to delay a little longer the day when their landfill activities will have to be confined to the disposal of non-salvable non-combustible material.

5.5.5 DEPTH OF LANDFILLS

The depth to which refuse may be placed in a landfill depends upon a number of factors - the depth of the depression to be filled; the permissible change in topography, especially in flat areas where the trench-fill must be used; the difficulty of preventing surface cracks and subsequent invasion of the fill by rats, or the release of odors; the use to which the filled land is to be put; the method of fill construction; and similar considerations. For fills to be put to useful purpose in a reasonable number of years a maximum depth of about 8 feet has been advocated. In practice, however, much deeper fills are generally constructed.

In California where the landfill method is widely used the depths of the trenches varied from 6 to 12 feet and the total depth of refuse in the fill ranged between 10 and 20 feet.

5.5.6 COVER OVER LANDFILL

The minimum depth of earth cover of 2 feet usually recommended for satisfactory operation of landfills is based on the maximum distance a rat will burrow (12 inches) plus an allowance for uneven settlement of the fill. In individual cases the depth of cover used depends on proposed use of the finished fill, the degree of compaction, the availability and cost of fill material, and similar considerations. On well compacted fills 12 inches of cover has often proved satisfactory, while those to be put to some useful purpose in the near future may require 3 or 4 feet of cover. In general, the depth of cover used on sanitary land fills varies from a few inches to 2 feet or more. The thinner cover seems characteristic of area-fills while the thicker cover is most often found on trench-fills where providing adequate cover has little effect on the economy of the disposal operation.

5.5.7 COMPACTION OF LANDFILLS

It is extremely important that a high degree of compaction be secured in any sanitary landfill. The need for compaction if the filled land is to be used as an area on which to construct buildings has long been evident. Only recently, however, has its importance in connection with engineering economics been seriously considered.

Compaction ratios, defined as the ratio of volume of refuse delivered to the site to its volume in the completed fill, for a number of cities is shown in the following table along with other pertinent data.

	Compaction Ratio	Land Requirement	
Berkeley, Calif.	2.0	2.4	7.7
Fresno, "	2.5	2.1	6.6
Lodi, "	3.7	4.0	13.7
Riverside, "	-	3.5	11.4
Sacramento, "	-	1.8	5.7
Stockton, "	-	3.7	10.7
Winnetka, Ill.	4.9	-	-

Inasmuch as the methods used for compaction in California cities are those commonly used elsewhere, it is reasonable to assum that 2.5 to 3 represents the usual compaction ratio. Various reports have assumed the compaction ratio be 3.3 for a good degree of compaction.

5.5.8 LAND REQUIREMENTS

The land requirements for sanitary fills is closely related to the degree of compaction achieved. Its extreme importance lies in the degree to which available area is the factor that limits the application of the sanitary landfill method of refuse disposal. The typical judgment of municipal officials in many cities is that the sanitary landfill method of disposal is good and very economica however, the scarcity of fill areas makes it almost mandatory that a more permanent method of disposal be developed.

Where suitable land is available with a topography suitable for landfill operations it may be safely assumed that one acre per year of area will be required for each 10,000 population. This is based on the assumption that the depth of combined refuse and earth fills will be about 9 feet.

5.5.9 USE OF LANDFILLS

One of the principal virtues of the sanitary landfill method of refuse disposal is the reclamation of useful land area from former swamps, marshes, tidelands, etc. The City of New York has created thousands of acres of parks, buildings, and residentia sites, and four areas presently being filled will become huge park with golf courses, tennis courts, baseball diamonds, and other recreational facilities. In Baltimore the area being filled will be developed as a recreational site to be maintained by the Bureau of Parks. Similar building and park areas are being created in th District of Columbia, in Los Angeles, and in numerous other Americ cities. Some landfills in St. Louis are being used for truck terminals and a bulk oil distributing plant. In Berkeley, California, the Golden Gate Fields race track and adjacent automobile parking area occupy a part of the 120 acres already reclaimed by the refuse fill and once intended for an airport. San Francisco has reclaimed 140 acres and light industry is operating on 36 acres of the original fill. Fresno, California has grown crops on the top of its fill; and Winnetka is utilizing part of the completed fill as an auxiliary municipal service yard.

In general, almost every sanitary landfill is expected to yield new land area for some useful purpose. Settlement of fill therefore, becomes an important factor. In it is involved, as previously noted, the whole matter of depth of fill, methods of construction, and degree of compaction. In San Francisco elevation observations have been made since 1944 although some records are meager because of the disturbing of bench marks by settling. The records do show, however, that the rate of subsidence decreases after 3 or 4 years. A fill placed in 1940 settled 3 to 5 inches per year during the four year period from 1949 to 1953. Light industrial buildings recently constructed on the fill are built on telescoping concrete columns in order to compensate for settlement and maintain the building floor at its design elevation.

The highly compacted fill at Winnetka, Illinois has settled rather evenly with only a 4 inch subsidence being noted in the sections that have been completed one year or more.

The loads which may be superimposed on a refuse fill limit its use as far as buildings are concerned, unless, of course, it is desired to carry foundations completely through the fill and onto solid strata. Generally mat foundations are used which spread the building load over the entire building area. Extreme caution must also be exercised if the fill is to be opened for the construction of utility lines. Difficult problems may result from odorous conditions, excessive corrosion of pipes or conduits, and rupture due to inequal settlement of the fill.

5.5.10 USE OF LANDFILLS IN DELAWARE COUNTY

Inasmuch as the garbage reduction, garbage composting and garbage grinding are not applicable to the present conditions obtaining in the county, there remains only consideration of the land fill and incineration methods. As they are elemental to the problem of refuse disposal in the county, they are covered in more detail in subsequent chapters of this report.

5.6 REFUSE INCINERATION

5.6.1 EARLY INCINERATOR PLANTS

The practice of disposing of municipal waste by burning was first introduced in England in 1874 when a plant for the destruction of mixed refuse was constructed in Nottingham. A simila improved plant was constructed two years later in Manchester and the success of those early installations was sufficiently satisfactory to promote further rapid development of this method of disposal in that country.

It was not until eleven years later, 1885, that this metho of waste disposal was introduced in the United States, the first plant being constructed at Governors Island, New York and the firs municipal plant was built in Allegheny City, Pennsylvania, during the same year.

Early American and European experience with incineration (or destriction or cremation as it is sometimes called) differed greatly, principally due to the fact that the European furnaces were constructed to burn mixed refuse (garbage, rubbish, and ashes whereas the American incinerators or crematories were used to destroy only garbage. The European mixed refuse destructors were able to destroy the materials without the use of additional fuel while the American plants generally depended upon the heat produced by the burning of added fuel to dispose of wet garbage. In American cities ample dumping spaces were usually available at convenient location for disposal of rubbish and ashes at low cost, and therefore the early American installations were usually concerned only with the destruction of garbage which could not be disposed of by dumping without creating a nuisance.

Early American garbage furnaces generally were relatively inexpensive low temperature furnaces requiring additional fuel for the burning of garbage. The failure of these early American installations, according to several authorities, was due to incorrect design, slow combustion, faulty material, unskilled operators and the tendency to use too little fuel. However many of these early plants gave satisfactory service and especially when located where occasional odors produced through incomplete combustion was not objectionable.

According to Herring and Greeley, the first successful attempt to adjust the English high temperature mixed refuse incinerator to American conditions was not accomplished until 1906 when a 60 ton plant was built at Westmount, a suburb of Montreal, Quebec, and was followed up by other similar plants at Vancouver, B.C., Seattle, Washington, West New Brighton, N. Y., and Milwaukee. All of these plants were equipped with boilers for steam raising and developed useful power in excess of that required for plant operation. About 1909 mechanical charging apparatus was developed and plants with this improvement were put in operation at Clifton, N.Y., Paterson, J. J. Savannah, Atlanta and other cities.

These incinerators were all of the "mutual - assistance" type, that is each unit consisted of three or more cells, alternately charged with the heat generated by the grates on which burning took place to dry out the material in the newly charged cells until it was ready for burning. Gases from the cells were delivered to a so called secondary combustion chamber where complete combustion of the mixed gases was to take place. Some of the contemporary makes of incinerator plants still use a secondary combustion chamber as they have two or three cells per unit, each cell being alternately charged.

5.6.2 LATER DEVELOPMENTS

During the 1930's studies were made of mechanically stoking of the incinerator units. The first commercial unit placed on the market was that developed by the Nichols Engineering and Research Corporation. This consisted of vertical cylindrical cells at the bottoms of which there was a rotating cone and arm which largely did away with the laborious hand stoking required on the older fixed grate incinerator plants. Up to the end of the year 1952 this company constructed about 70 plants of this type and more have been constructed since then.

The Morse-Boulger Destructor Company designed and constructed a vertical cylinder type of incinerator cell, which is somewhat similar to the type marketed by the Nichols Company except that the stoking section is provided with revolving arms. This company has constructed some 25 plants of this type. The costs of these two types of plants range between $3,000.00 and $3,500.00 per ton of rated capacity.

In the year 1941, Atlanta, Georgia, built an entirely different kind of incinerator plant which was of the type developed by Vollund of Copenhagen, Denmark. It consisted of a drying chamber into which the refuse was dumped from which the material is discharged into rotating horizontal drums, lined with refractory material and cleats to move the material. The gases of combustion then enter a combustion chamber equipped with waste heat boilers. The ash comes to the end of the rotary kiln and is discharged into a hopper from which it is dumped onto an underwater drag conveyor. Almost 2 pounds of steam are produced per pound of refuse burned. Los Angeles, California, constructed a rotary kiln type incinerator plant, patterned after the "Duerr Process". It is not equipped to produce steam as was the Atlanta plant.

In the year 1950 New York City constructed an incinerator plant consisting of two travelling grates in each unit. One grate at the charging end is inclined and serves as a drying grate. The other is horizontal on which the actual burning operation takes place. The residue is conveyed to the outlet end of the incinerator where it drops into an ash pit. This consists of a water sealed trough equipped with a scraper conveyor to transfer the residue to the trucks.

The Betz Avenue plant which was the first plant constructed has four units, each having a capacity of 200 tons per day, for a plant capacity of 800 tons per day. A second plant was completed about two years later, called the Gansevoort plant, which has a capacity of 1,000 tons per day. A third plant, South Shore, is nearing completion and will have a capacity of 1,000 tons per day. None additional plants of this type will be constructed to complete the City's refuse disposal program. They will have capacities ranging from 600 to 1,000 tons/day each. The listed costs of these plant is between $4,500.00 and $5,500.00 per ton of plant capacity.

The construction of a travelling grate type incinerator plant was recently completed at Framingham, Mass. This plant has two units, each unit having a rated capacity of 100 tons per day, or a total of 200 tons per day for the plant. Instead of using two grates, one inclined and the other horizontal, these incinerators have single horizontal travelling grate. An unusual feature of this plant is the use of water cooled, tubular walls, instead c refractory linings as are used in other types of incinerator plant Flue gas passes through a scrubber which removes practically all fly ash and particulate matter. This type of scrubber requires a considerable amount of water so plants of this type should be located nearby a continuous source of water supply. There are several manufacturers who supply this type of incinerator. The costs of incinerator plants using this type of equipment varies between $2,800.00 and $3,200.00 per ton of rated capacity.

A different type of incinerator plant was recently constructed by the City of Baltimore. The plant has four incinerator units, each having a rated capacity of 200 tons per day, or a tota capacity of 800 tons per day. The grates are of the fixed inclined type, and have hydraulicly powered stoker bars, which move the burning material from the top of the grate to the lower clinkering ends. The reported cost of this plant was $2,860.00 per ton of rated capacity.

5.6.3 LOCATION OF INCINERATOR PLANTS

Generally accepted criteria for locating an incinerator have been (1) to build on readily available land, and (2) minimize haul for maximum economy and convenience. However, there are othe important factors that should be considered for optimum location of a plant. In the largest metropolitan centers, it is generally not advantageous to build one big incinerator to handle all the refuse but, rather, to construct smaller units strategically place If possible, it is desirable to locate the plants in industrial areas, where odors from the collecting vehicles and fly ash from the plant impose minimum nuisance. Furthermore, refuse salvage an waste heat utilization can best be undertaken close to the ultimat market.

Another important factor in building an incinerator is to locate it, so that if possible, there is available two-level topography. Ideally, the collected refuse should be directly dumped in at the top level, burned within the combustion chambers at an intermediate level while the ashes are removed at the bottom elevation and finally disposed of in a nearby pit. Hillsides are adaptable for such two-level construction. Thus minimum mechanical refuse handling equipment and ramp building or tunnel excavation is required. Ash residue disposal involves a significant portion of the refuse collected ranging between 5 to 30% by volume A plant location with nearby ash disposal is economically desirable.

Incinerator ash disposal may also be required to meet local water pollution control laws. Zoning ordinances may restrict the location of a plant. While it is true that it is possible to place incinerators in expensive, totally-enclosed structures so that there is a minimum of nuisance, movements of heavy collection vehicles on the streets and some noises and odors cannot be avoided.

5.6.4 BY-PRODUCT HEAT

Most American refuse contains an average calorific content of between 3,500 and 4,500 BTU per pound. This amount of heat energy will vaporize approximately 3 to 4 pounds of water into steam. In practice, incinerators have been able to produce betwee 1-1/2 and 2-1/2 pounds of steam per pound of refuse burned. In addition to supplying utilizable heat, refuse must first produce the heat energy required for (1) maintaining combustion gases and incinerator refractories at high temperatures; (2) vaporization of the moisture present in the refuse; (3) raising the temperature of freshly introduced refuse to the kindling point; and (4) pre-heating draft air.

5.6.5 SALVAGING OF BY-PRODUCTS

Ashes and clinker have been used to a limited extent in the United States for road building and light-weight concrete manufacture. Complete, but economical, high-temperature burning is required to obtain an organic-free ash suitable for such utilization. Ashes have also been used for fertilizer and fly ash from the secondary chamber may be employed as an inert base in the preparation of insecticides and other powder-base industrial products. The salvage of tin cans, either before or after partial burning, represents another waste product that is sometimes profitable in conjunction with normal plant operation. Atlanta and Miama, have successfully carried out ash and tin can by-product utilization.

5.6.6 COMPONENTS OF CONTEMPORARY PLANTS

5.6.6.1 Contemporary Incinerator Design

Much has been accomplished in modern incinerator design in the past ten years. Incinerator design is primarily a combustion problem. The pressing need for incinerators for municipal service has lately drawn the combustion engineers from power plant work to design units for the proper combustion of refuse. They hav applied to the design of refuse incinerator plants the accumulated knowledge of many years experience in design of industrial and utility power plants using a great variety of fuels including wet bark, refuse wood, bagasse (sugar cane stalks), and various other industrial waste products as well as the well known fuels such as coal, oil and gas.

Contemporary incinerator design incorporates such features as travelling grates or power stokers which provide for the contin uous burning of the refuse and thereby maintain consistently high temperatures of combustion and not the variations encountered in the batch charging types. Mechanical ash handling facilities are provided to mechanically remove the ash, quench it and convey it to storage tanks or directly to trucks.

5.6.6.2 Weighing

In large capacity installations it is desirable to use recording platform scales which operate semi-automatically and are able to weigh and record 60 to 70 refuse trucks per hour with minimum standing time. The plant should be laid out so that straight line flow is employed; after the refuse is weighed, the truck shou be driven forward to the dumping floor avoiding, if possible, any necessity to back out, so that it may return to the collection route rapidly. The weighmaster should keep careful weight records classifying the loads whenever possible.

After weighing, the weighmaster should direct the truck driver to the point where the refuse should be dumped so that (1) heat energy of refuse charged to the incinerator furnace will be maintained as constant as possible, and (2) the materials handling is reduced.

5.6.6.3 Unloading

Many incinerators operate 4 to 8 hours a day with refuse unloading in proximity or directly into the primary or furnace chamber. In such installations no provision is made for storage of the unloaded refuse. This is often unsatisfactory, since the plant cannot be maintained in a clean sanitary condition when refuse is piled on the dumping floor. On the other hand, where storage pits are employed, considerable expense is introduced for the use of overhead mono-rail or bridge cranes to charge the refus into the furnace. One disadvantage of directly charging the refus from the collection truck into the primary chamber is that it is impossible to maintain continuous, small volume charging. With the batch process the furnace is either underloaded or overloaded. At Pasadena, California, a small 80 cubic yard storage bin is emptied by a movable, metal endless belt, approximately 15 feet wide, to efficiently and almost continuously feed refuse into the burning chamber.

In several recent designs it is proposed to dump the refuse material into shallow pits having metal, endless belts to convey the refuse to the incinerator inlets. One belt is to be provided for each incinerator unit, the speed of which will be automatically varied to meet the burning rate of the incinerator. Such features eliminate top floor charging to the incinerator units and also the expensive storage pits and overhead bridge cranes.

5.6.6.4 Charging Inlets

The charging gates in most modern plants are operated hydraulicly, pneumatically, or electrically. The charging inlet may vary in size from less than 4' to 6' to as much as 5' x 15'. Observations on many municipal incinerators indicate that the amount of air introduced into the furnace thru the charging gate when charging does not seriously deter the burning process because (1) the fresh refuse requires additional oxygen and (2) the differential gas pressure at the inlet is slight. Large inlets are desirable so that tree stumps, boxes and other refuse which would otherwise require considerable labor to reduce their size may be fed into the incinerator.

5.6.6.5 Burning Operation

For maximum performance of an efficient plant the furnace should continuously feed refuse to the burning hearth while the residue and ash are removed. The rotating kiln furnace provides a method of continuous feed and ash removal. Unfortunately it is an expensive plant to build. The inclined, fixed, power stoker grates provides another method of continuous feed. Manually operated ash dumps are used with this method. The travelling belt type of grate is probably the most effective method of securing a continuous feed of the refuse, its drying, burning and the continuous removal of the residue and ash.

Forced draft should be provided by blowing in air at atmospheric temperatures, properly distributed under the grates in accordance with the burning requirements. The high ratio of rubbish and the consequent high BTU value of the refuse will require the use of overfire air introduced above the burning area.

The combustion chambers should have large volumes in order that burning of gases and particles carried in the gases may be properly completed. The flues connecting the chambers to the chimney should also be large so the gases will travel at a low velocity to allow ample time and space for complete burning and for settling out of the larger particles of fly ash.

5.6.6.6 Removal of Fly Ash and Particulate Matter

With the areas considered for incinerator plant location it is important that all fly ash and the major portion of the particulate matter contained in the flue gas be removed. At present there are no generally well defined regulations as to the amount c dust that can be emitted from smoke stacks. In general, terms, the American Society of Mechanical Engineers code gives a maximum figure for dust emission of 0.85 pounds per 1,000 cu.ft. of gas, adjusted to 50 per cent excess air and a maximum required collector efficienty of 85 per cent.

Public utilities have long been cognizant of the need for fly ash elimination as indicated by the fact that the first electrostatic precipitator was installed for this purpose more than 30 years ago. Today electrostatic fly ash collectors form an integra part of many pulverized coal fired boiler installations. Their inclusion is due to the recognition of management to the importanc of public relations and community responsibility.

It has only been during the past 5 years or so that municipal officials have recognized the importance of dust and smoke control from incinerator plants. This has been due largely to the effective campaign of smoke and dust control agencies to prevent air pollution. Many of the chimneys of the older and contemporary incinerator plants belch smoke and dust during the burning periods This is largely due to the design features of the plant and the failure to provide effective dust and smoke control devices.

Particulate matter may be removed from the combustion gase through the medium of (1) baffle chambers, (2) gas expansion and sedimentation chambers, (3) complicated duct work, (4) cyclone precipitators, (5) dynamic centrifugal precipitators, (6) sonic glomerators, in conjunction with cyclonic precipitators, (7) wet chamber employing a water bath or water spray, (8) bag filters made of steel or glass mesh, and (9) electrostatic precipitators. However, control of particulate matter is costly, and the finer particles are not completely removed by even the best processes. Tests of stack gases indicated that fly ash may represent as much as 1% by dry weight of the total ash produced. Large burning fly ash particles may cause fires in the surrounding area, besides

6.1.2. POSSIBLE POWER GENERATION

Consideration was given to the generation of power by the utilization of the waste heat in the gases of combustion to provide a source of income. The only possible user of such power would be the Philadelphia Electric Company, who would have to tie in the power generated in each plant with its present power producing and distribution facilities. The cost of such facilities and the inherent difficulties of distribution are such that little is to be gained by waste heat recovery. Waste heat boilers and power generating facilities were, therefore, not included in the studies.

6.1.3. COMPARISON BASED ON ENTIRE COUNTY

For comparative cost purposes with landfill this study has been based on the burning of refuse as derived from the entire county. Actually this will not be so as the hauling costs from the outlying present sparsely settled areas in the westerly and northwesterly parts of the county do not now warrant the inclusion of refuse from these areas for burning in any of the three incinerator Schemes discussed herein. However, populations in these areas may increase faster than anticipated and it may be necessary to include the refuse from these areas for disposal by burning.

6.2. PROPOSED INCINERATOR PLANTS

6.2.1. CAPACITIES

The capacities of the proposed incinerator plants should be based on the burning of the maximum day refuse in a 16 hour operating day (2 shifts) and 300 days per year. Should one unit be down for repairs the other units would have to operate about 24 hours to burn the refuse on days of maximum collection.

6.2.2. DESIGN OF INCINERATORS

The design of the incinerator plants should preferably be of the continuous flow type, with equipment for the continuous movement of refuse material in and from the receiving pit, through the furnace, with the residue delivered to an overhead storage bin. The continuous and regulated flow permits controlled combustion, controlled temperature and controlled air for combustion and cooling, even though the material varies greatly in percentage of combustibles and moisture.

The furnace design should preferably be of the water cooled type that permits a heat recovery system to be provided and greatly reduces the expensive maintenance in refractory type plants. The hot water recovered will be used to heat the buildings.

Each unit should be complete and separate throughout from receiving pit to the residue discharge conveyor. Each unit should be complete in itself with a Receiving Pit, Refuse Handling System, Stoker, Furnace, Forced Draft Fan, Overfire Air Fan, Induced Draft Fan, Flue Gas Scrubber, Residue Discharge Conveyor, Controls, Thermometer Gage Recorders, Motors and Starters, Control Panel, Sifting Ash Removal System, Ductwork, Piping and Walkways.

6.2.3. RECEIVING PIT AND REFUSE HANDLING SYSTEM

Each Receiving Pit should have sufficient storage capacity for the full 16 hour furnace operations. The pits should be constructed of reinforced concrete and be equipped with drag chain type conveyors. The material should move lengthwise in the pit and be discharged on a steel pan apron type conveyor which transports it up a 30 degree (max.) slope to feed the Charging Hopper of the furnace. The rate of movement of refuse in the Pit and up the inclined conveyor should be controlled and coordinated to maintain the Charging Hopper full but not overburdened. Controls should also be provided to permit manual operation of the equipment to speed movement of initial deliveries to the Receiving Pit. Fire Control Sprinkler Systems and Odor Neutralizer Spray Systems should be provided in storage areas.

6.2.4. STOKERS

Each unit should be provided with a stoker designed to handle the refuse as delivered to the Incinerator Plants during the normal 16 hour day and to reduce this material to a residue containing not over five percent of weight of combustible material.

The stoker should be of the traveling grate type which provides a continuous movement of burning refuse through the furnace. Manually adjusted variable speed controls should be provided for the operation of the grates, so the speed of operation may be adjusted to suit the burning rate, according to the observation of the ashes falling off the end of the grates.

The grate design should allow for passage of forced draft air thru at least ten (10) percent of the effective grate surface and minimizes the sifting of ashes through the air passages. The grates should be designed for severe duty and the materials should be suitable for high temperatures and abrasive conditions. The elements of the grates should be accessible so they can readily be replaced in case of failure. The grates should be trouble free under incinerator conditions of molten glass, slag and metals. Provisions should be made for thermal expansion of grate elements and surface.

6.2.5. FURNACE

Each unit should preferably be provided with a Furnace of the forced circulation water cooled type, properly proportioned to assist the stoker in the combustion of refuse materials. The Furnace should be provided with a Charging Hopper of sufficient cross section to minimize plugging. The Charging Hopper should provide restriction of air entering the furnace by sufficient height or by mechanical means. No opening for passage of material to the furnace should have a dimension of less than four (4) feet. The Furnace volume is considered as only that in the Furnace and over the grates and ash pit. Complete combustion takes place in the Furnace and therefore no secondary chamber should be needed.

The tubular construction of the water cooled Furnace will recover much of the heat generated and reduce the amount of refractory insulation needed. This water tube construction eliminates the high refractory maintenance costs that have caused so much trouble in many incinerator designs and is also lower in initial construction cost.

Each Furnace should be provided with an ash pit sealed by mechanical means to reduce air leakage, to the extent that a negative pressure can be maintained in the furnace and ashes are not blown into the flue gas stream.

6.2.6. FANS

Each unit should be supplied with a Forced Draft Fan to supply air at the fire level for controlled combustion. An Overfire Air Fan should also be provided to supply air in the Furnace Chamber to maintain proper combustion temperatures.

An Induced Draft Fan should be provided to aid the natural flow of the flue gases through the scrubber and to hold a negative air pressure in the furnace.

Thermocouples should be provided to control the operation of the fans to maintain in the furnace temperatures of 1600° F (plus or minus 100° F). At this temperature odors are completely destroyed and combustion of rubbish, garbage or sewage sludge is complete.

Temperatures over 1800° F melt the ash, causing slag accumulation on the furnace and flue walls.

6.2.7. SCRUBBERS

The gases from the furnace should pass through a wet type flue gas scrubber which removes particulate matter of all sizes so that the emission should not exceed 0.05 pounds per 1,000 pounds of flue gas. The exit gases from the furnace should be 1400° to 1800° F and the scrubbers should be designed to handle such temperatures.

6.2.8. RESIDUE DISCHARGE CONVEYORS

The residue from the units will drop from the grates through an air lock, on to a steel pan apron type conveyor which will deposit the residue in an ash storage pit or to trucks. Should ash storage pits be used they should be arranged for gravity discharge to trucks.

A vacuum hose type system should be provided for removal of the ash siftings below the grates.

6.2.9. CONTROLS

Controls are to be provided to maintain a uniform negative pressure in the furnace, to maintain a Furnace Gas Temperature of 1600° F. (plus or minus 100° F), to regulate water flow for furnace wall cooling, to regulate the refuse handling system, and to automatically regulate any other devices necessary to provide a continuous flow type incineration without smoke or odor.

The operations of the entire plant through the use of these controls will provide a continuous flow of materials with a minimum of manpower.

6.2.10. WATER FOR SCRUBBERS

As previously noted the large amounts of water required for the flue gas scrubbers to remove the dust and fly ash from the combustion gases will be taken from the water courses or creeks alongside of which the proposed plants will be constructed.

6.2.11. ASH AND CLINKER DISPOSAL

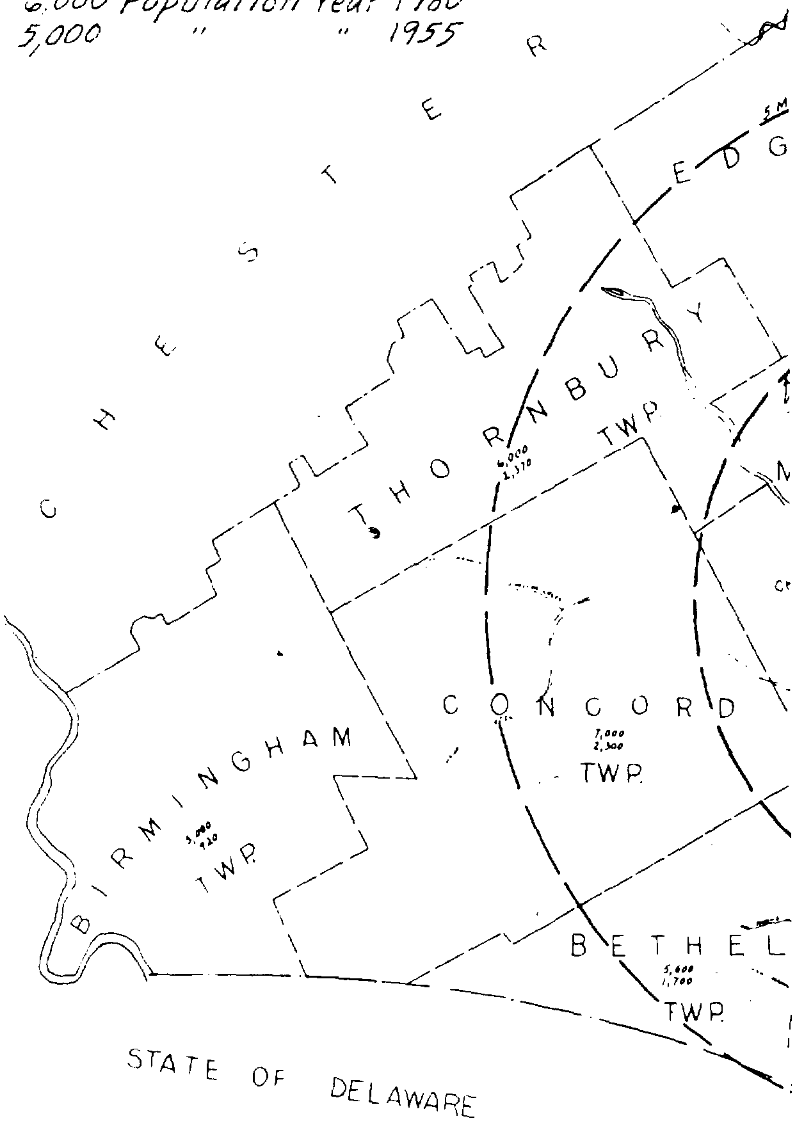
The range in volume of the ash and clinker in the burning of refuse is between 5 and 30 percent of the original volume. A large part of this is tin cans, bottles, and other incombustible material. Even with an average reduction in volume of 20 percent and in weight of 10 percent, there still remains a considerable volume of ash and clinker to be disposed of.

DELAWARE COUNTY INCINERATOR
DELAWARE COUNTY, PENN

DAMON & FOSTER
CONSULTING ENGINEERS
SHARON HILL, PA.
COTTON, PIERCE, STREANDER, INC.
ASSOCIATE ENGINEERS
NEW YORK CITY, N.Y.
MARCH 1956

Scheme "A"
2 Incinerator Plants

Legend
6.000 Population Year 1980
5,000 " " 1955



In this study it is proposed to place the incinerator plants at such locations that ground will be available at the plant sites for the disposal of ash and clinker by what actually will be land fill. This is not land fill as used for the disposal of refuse, but rather a modification thereof as the clinker can be placed to considerable depths. Earth cover need only be provided when the fill reaches its maximum depth.

Provisions have been made in the cost of the various plans for the inclusion of trucks to haul the ash and clinker to the nearby dumping area. As the organic matter present in the original refuse has been destroyed by burning such dumping areas will not create an aerial nuisance. They, however, may be somewhat unsightly which could be overcome by placing a thin earth fill over the fresh dump every week or so.

6.3. OUTLINE OF POPULATIONS SERVED AND PLANT CAPACITIES

6.3.1. SCHEME A - TWO INCINERATOR PLANTS

6.3.1.1. Outline of Plan

Under Scheme A it is proposed to construct two incinerator plants at the locations previously given and as shown on Figure No. 3. In this figure there are given 3 mile and 5 mile radii of collection for each of Districts A and B. Crum Creek forms the natural dividing line between the two districts, but the collection distances in the two districts may be such that refuse from in between areas may be taken to either plant. The two plant scheme involves rather long haulage from centers of dense populations and thus involves high hauling costs.

6.3.1.2. Populations to be Served by Each District

The municipalities included in each district and their populations for the years 1955 to 1980 inclusive are given in the following tabulations:

Population District A

	1955	1960	1970	1980
Aldan Borough	4,140	4,400	4,790	4,900
Clifton Heights Borough	8,040	8,400	8,900	9,000
Collingdale Borough	10,000	10,700	10,900	11,000
Colwyn Borough	2,200	2,300	2,460	2,700
Darby Borough	14,120	14,600	14,800	15,000
Darby Township	9,990	11,900	13,600	14,000
East Lansdowne Borough	3,610	3,700	3,760	3,800
Folcroft Borough	4,430	5,700	7,300	8,000
Glenolden Borough	7,410	8,000	8,350	8,400
Haverford Township	49,460	55,000	64,000	68,000
Lansdowne Borough	12,940	13,600	14,000	14,100
Marple Township	11,180	15,600	22,000	27,500
Millbourne Borough	900	910	925	940
Morton Borough	1,800	1,900	1,950	2,000
Newtown Township	6,290	10,800	18,600	20,000
Norwood Borough	5,660	5,840	5,920	6,000
Prospect Park Borough	6,480	7,000	7,500	7,600
Radnor Township	18,370	22,000	28,200	30,000
Ridley Township	26,800	30,000	31,400	32,000
Ridley Park Borough	6,580	7,400	7,760	7,800
Rutledge Borough	950	960	980	1,000
Sharon Hill Borough	6,500	7,000	7,500	7,700
Springfield Township	21,650	25,400	28,800	30,000
Swarthmore Borough	5,830	6,120	6,250	6,300
Tinicum Township	5,800	5,900	6,350	6,400
Upper Darby Township	91,280	94,300	98,000	100,000
Yeadon Borough	11,470	11,450	12,100	12,200
TOTAL POPULATIONS	353,880	390,880	437,095	456,340

Populations District B

Aston Township	6,740	8,350	11,000	14,000
Bethel Township	1,700	2,320	3,600	5,000
Birmingham Township	920	1,800	3,350	5,000
Brookhaven Borough	3,030	4,100	6,000	8,000
Chester Township	4,080	6,250	11,350	12,000
Chester Heights Borough	490	700	2,250	3,000
City of Chester	70,280	73,500	76,500	78,000

	1955	1960	1970	1980
Concord Township	2,300	3,200	6,000	7,000
Eddystone Borough	3,230	3,400	3,600	3,800
Edgemont Township	1,280	2,100	3,500	5,000
Lower Chichester Township	3,350	3,950	5,160	7,000
Marcus Hook Borough	3,870	3,870	3,950	4,000
Media Borough	6,250	6,800	7,000	7,200
Middletown Township	7,140	8,500	16,850	20,000
Nether Providence Township	8,220	12,500	15,300	16,000
Parkside Borough	2,080	2,230	2,300	2,350
Rose Valley Borough	560	620	990	1,150
Thornbury Township	2,370	2,750	4,300	6,000
Trainer Borough	2,080	2,200	2,600	2,850
Upper Chichester Township	7,740	9,050	18,000	21,000
Upper Providence Township	4,980	6,180	10,900	12,000
Upland Borough	4,840	5,200	6,000	6,400
TOTAL POPULATIONS	147,530	169,570	220,500	246,750

6.3.1.3. Amounts of Refuse From Each District

Based on the maximum of 3.22 pounds of refuse per day per capita the following total amounts of refuse must be burned on the maximum day:

District A	1955	1960	1970	1980
Population	353,880	390,880	437,095	456,340
Tons per day	569.8	629.3	703.7	734.7
District B				
Population	147,530	169,570	220,500	246,750
Tons per day	237.5	273.0	355.0	397.3
Totals				
Population	501,410	560,450	657,595	703,090
Tons per day	807.3	902.3	1058.7	1132.0

6.3.1.4. Incinerator Plant Capacities

Based on the foregoing amounts of refuse and an operating period of 16 hours the amounts of refuse to be burned and the required plant capacities for the years 1955 to 1980 inclusive would be as follows:

District A	1955	1960	1970	1980
Tons per day	569.8	629.3	703.7	734.7
Equivalent tons in 16 hours	855	944	1055	1102
Capacity tons per 24 hours	900	1000	1200	1200
Number of units	3	3 or 4	4	4
Tons capacity each unit	300		300	300
District B				
Tons per day	237.5	273.0	355.0	397.3
Equivalent tons in 16 hours	357	410	533	597
Capacity tons per 24 hours	400	450	600	600
Number of units	2	2 or 3	3	3
Tons capacity each unit	200	200	200	200

In the foregoing tabulation the incinerator capacity requirements for the year 1960 are such that the construction of one unit could possibly be postponed to a later time. The shut down of one of the remaining units would however lessen the capacities of the plants to the point where they could not handle the maximum month or week refuse burning loads, particularly for the plant in District B. For this reason the full complement of burning units has been included in this study.

6.3.2. SCHEME B - THREE INCINERATOR PLANTS

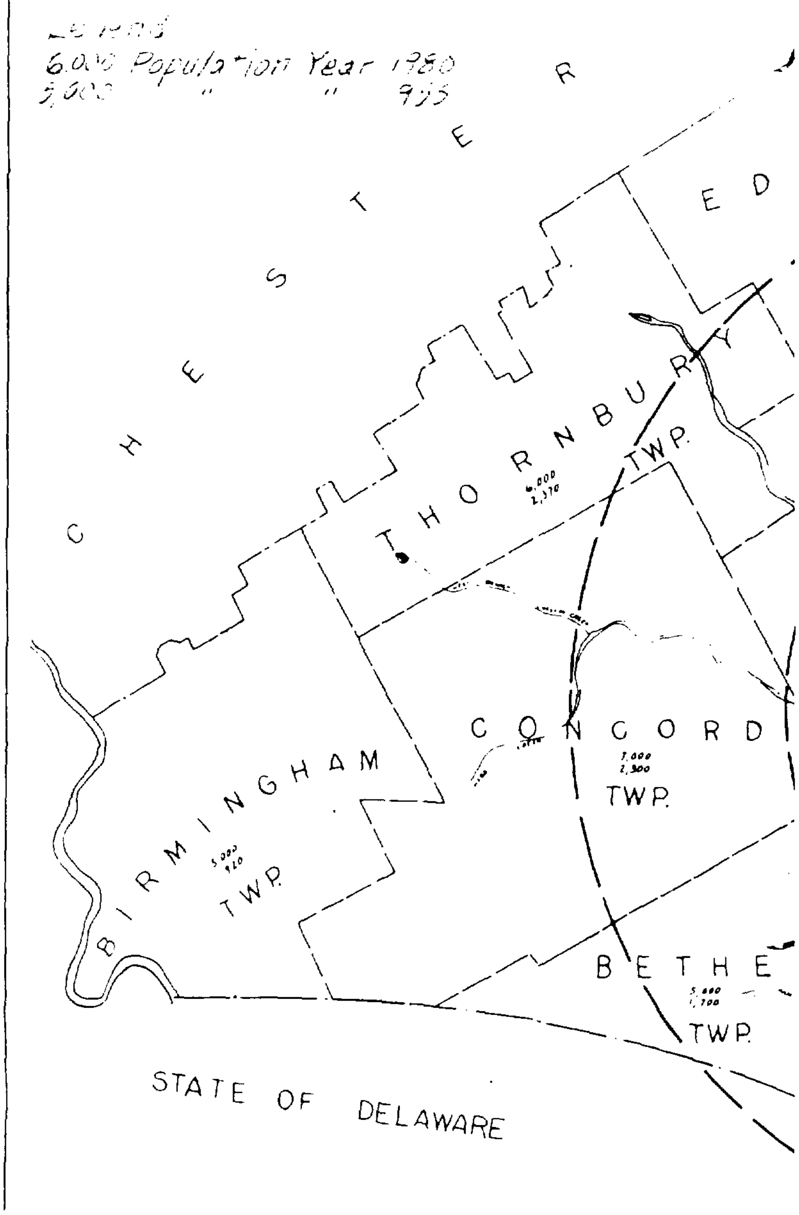
6.3.2.1. Outline of Plan

Under Scheme B it is proposed to construct three incinerator plants at the locations previously given and as shown on Figure

DELAWARE COUNTY INCINERATOI
DELAWARE COUNTY, PENI

DAMON & FOSTER
CONSULTING ENGINEERS
SHARON HILL, PA.
COTTON, PIERCE, STREANDER, INC.
ASSOCIATE ENGINEERS
NEW YORK CITY, N.Y.
MARCH 1958

Scheme "B"
3 Incinerator Plants



No. 4. In this figure there are given the 3 and 5 mile radii of collection for each of Districts A, B and C. This plan provides more favorable haulage distances for Radnor and Haverford Townships and also reduces the haulage for the municipalities in the south-easterly part of the County. It takes recognition of the established location of the present incinerator plant now owned and operated by Haverford Township. Under this scheme of disposal the Delaware County Incinerator Authority would purchase the plant and the land from Haverford Township and construct a new plant to serve District A. Hauling costs for this scheme of refuse disposal would naturally be less than for Scheme A, Two Plants.

6.3.2.2. Populations to be Served by Each District.

The municipalities included in each district and their populations for the year 1955 to 1980 inclusive are given in the following tabulations:

Population - District A	1955	1960	1970	1980
Haverford Township	49,460	55,000	64,000	68,000
Marple Township	11,180	15,600	22,000	27,500
Millbourne Borough	900	910	925	940
Newtown Township	6,290	10,800	18,600	20,000
Radnor Township	18,370	22,000	28,200	30,000
Upper Darby Township	91,280	94,300	98,000	100,000
Totals	177,480	198,610	231,725	246,440

Population - District B				
Aldan Boro	4,140	4,400	4,790	4,900
Clifton Heights Borough	8,040	8,400	8,900	9,000
Collingdale Borough	10,000	10,700	10,900	11,000
Colwyn Borough	2,200	2,300	2,460	2,700
Darby Borough	14,120	14,600	14,800	15,000
Darby Township	9,990	11,900	13,600	14,000
East Lansdowne Borough	3,610	3,700	3,760	3,800

	1955	1960	1970	1980
Eddystone Borough	3,230	3,400	3,600	3,800
Folcroft Borough	4,430	5,700	7,300	8,000
Glenolden Borough	7,410	8,000	8,350	8,400
Lansdowne Borough	12,940	13,600	14,000	14,100
Morton Borough	1,800	1,900	1,950	2.000
Norwood Borough	5,660	5,840	5,920	6,000
Prospect Park Borough	6,480	7,000	7,500	7,600
Ridley Township	26,800	30,000	31,400	32,000
Ridley Park Borough	6,580	7,400	7,760	7,800
Rutledge Borough	950	960	980	1,000
Sharon Hill Borough	6,500	7,000	7,500	7,700
Springfield Township	21,650	25,400	28,800	30,000
Swarthmore Borough	5,830	6,120	6,250	6,300
Tinicum Township	5,800	5,900	6,350	6,400
Yeadon Borough	11,470	11,450	12,100	12,200
Totals	179,630	195,670	208,970	213,700

Population - District C

Aston Township	6,740	8,350	11,000	14,000
Bethel Township	1,700	2,320	3,600	5,000
Birmingham Township	920	1,800	3,350	5,000
Brookhaven Borough	3,030	4,100	6,000	8,000
Chester City	70,280	73,500	76,500	78,000
Chester Township	4,080	6,250	11,350	12,000
Chester Heights Borough	490	700	2,250	3,000
Concord Township	2,300	3,200	6,000	7,000
Lower Chichester Township	3,350	3,950	5,160	7,000
Marcus Hook Borough	3,870	3,870	3,950	4,000
Media Borough	6,250	6,800	7,000	7,200
Middletown Township	7,140	8,500	16,850	20,000
Nether Providence Township	8,220	12,500	15,300	16,000
Parkside Borough	2,080	2,230	2,300	2,350
Rose Valley Borough	560	620	990	1,150
Thornbury Township	2,370	2,750	4,300	6,000
Trainer Borough	2,080	2,200	2,600	2,850
Upland Borough	4,840	5,200	6,000	6,400
Upper Chichester Township	7,740	9,050	18,000	21,000
Upper Providence Township	4,980	6,180	10,900	12,000
Edgemont Township	1,280	2,100	3,500	5,000
Totals	144,300	166,170	216,900	242,950

6.3.2.3. Amounts of Refuse From Each District

Based on the maximum of 3.22 pounds of refuse per capita per day the following total amounts of refuse would be collected per day from each district:

District A	1955	1960	1970	1980
Population	177,480	198,610	231,725	246,440
Tons per day	285.7	319.8	373.1	396.8

District B				
Population	179,630	195,670	208,970	213,700
Tons per day	289.2	315.0	336.4	344.1

District C				
Population	144,300	166,170	216,900	242,950
Tons per day	232.3	267.5	349.2	391.1

Totals				
Populations	501,410	560,450	657,595	703,090
Tons per day	807.2	902.3	1058.7	1132.0

6.3.2.4 Incinerator Plant Capacities

Based on the foregoing amounts of refuse and an operating period of 16 hours the amounts of refuse to be burned and the required plant capacities for the year 1955 to 1980 inclusive, would be as follows:

District A	1955	1960	1970	1980
Tons per day	285.7	319.8	373.1	396.8
Equivalent tons in 16 hrs.	428.5	480	560	596
Capacity tons per 24 hrs.	429	500	600	600
Number of units	2 or 3	2 or 3	3	3
Tons capacity each unit	200	200	200	200
District B				
Tons per day	289.2	315.0	336.4	344.1
Equivalent tons in 16 hrs.	434	473	504	516
Capacity tons per 24 hrs.	450	500	600	600
Number of units	2 or 3	2 or 3	3	3
Tons capacity each unit	200	200	200	200
District C				
Tons per day	232.3	267.5	349.2	391.1
Equivalent tons in 16 hrs.	349	400	524	586
Capacity tons per 24 hrs.	400	400	600	600
Number of units	2	2	3	3
Tons capacity each unit	200	200	200	200

In the foregoing tabulation the incinerator capacity requirements for the year 1960 are again such that the construction of one unit could possible be postponed to a later time, this being particularly true for the plant proposed for District C. The shut down of one unit would, however, lessen the capacities of the plants to the point where they could not handle the maximum day refuse burning loads. For this reason the full complement of burning units has been included in this study.

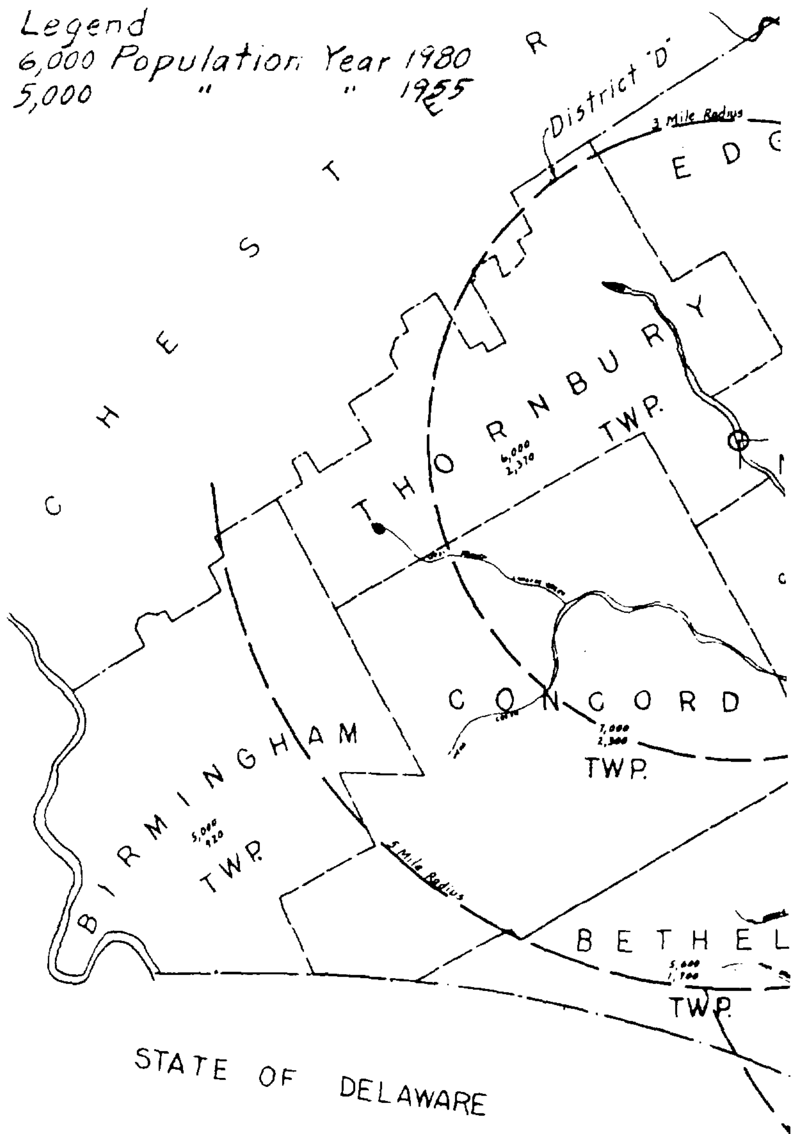
DELAWARE COUNTY INCINERATOR
DELAWARE COUNTY, PENN

DAMON & FOSTER
CONSULTING ENGINEERS
SHARON HILL, PA.
COTTON, PIERCE, STREANDER, INC.
ASSOCIATE ENGINEERS
NEW YORK CITY, N.Y.
MARCH 1958

SCALE OF MILES

Scheme "C"
4 Incinerator Plants

Legend
6,000 Population Year 1980
5,000 " " 1955



As shown in the tabulation each incinerator plant would have the same capacity. This would allow standardization of the design, the only variation being the adaptability of each plant to its site.

6.3.3 SCHEME C - FOUR INCINERATOR PLANTS

6.3.3.1 Outline of Scheme

Under Scheme C it is proposed to construct four incinerato plants at the locations previously given and as shown on Figure No. 5. In this figure there are given the 3 and 5 mile radii for Districts A and D, the 3 mile radius for District B and the 2 and 3 mile radii for District C. This plan provides the least amount of haulage of any of the schemes. Districts A and B of this plan or scheme are considered to be the same as in Plan B, the three incinerator scheme. The incinerator plant location for District C has been located to provide a comparatively short haul for the most heavily populated areas of this district.

6.3.3.2 Populations To Be Served By Each District

The municipalities and populations included in Districts Nos. A and B of this plan are for all practical purposes the same as Districts A and B of Scheme B, the three incinerator plan or scheme. The municipalities and populations in these two districts will, therefore not be repeated, but only the total populations for the years 1955 to 1980 inclusive will be given.

Populations	1955	1960	1970	1980
District A	177,480	198,610	231,725	246,440
District B	179,630	195,670	208,970	213,700

District C	1955	1960	1970	1980
Aston Township	6,740	8,350	11,000	14,000
Bethel Township	1,700	2,320	3,600	5,000
Brookhaven Borough	3,030	4,100	6,000	8,000
City of Chester	70,280	73,500	76,500	78,000
Chester Township	4,080	6,250	11,350	12,000
Lower Chichester Township	3,350	3,950	5,160	7,000
Marcus Hook Borough	3,870	3,870	3,950	4,000
Media Borough	6,250	6,800	7,000	7,200
Nether Providence Township	8,220	12,500	15,300	16,000
Parkside Borough	2,080	2,230	2,300	2,350
Rose Valley Borough	560	620	990	1,150
Trainer Borough	2,080	2,200	2,600	2,850
Upland Borough	4,840	5,200	6,000	6,400
Upper Chichester Township	7,740	9,050	18,000	21,000
Totals	124,820	140,940	169,750	184,950

District D				
Birmingham Township	920	1,800	3,350	5,000
Chester Heights	490	700	2,250	3,000
Concord Township	2,300	3,200	6,000	7,000
Edgmont Township	1,280	2,100	3,500	5,000
Middletown Township	7,140	8,500	16,850	20,000
Thornbury Township	2,370	2,750	4,300	6,000
Upper Providence Township	4,980	6,180	10,900	12,000
Totals	19,480	25,230	47,150	58,000

6.3.3.3 Amounts of Refuse From Each District

Based on the maximum of 3.22 pounds of refuse per capita per day the following total amounts of refuse would be collected per day from each district:

District A	1955	1960	1970	1980
Population	177,480	198,610	231,725	246,440
Tons per day	285.7	319.8	373.1	396.8

District B				
Population	179,630	195,670	208,970	213,700
Tons per day	289.2	315.0	336.4	344.1

District C	1955	1960	1970	1980
Population	124,820	140,940	169,750	184,950
Tons per day	201.0	226.9	273.3	297.8
District D				
Population	19,480	25,230	47,150	58,000
Tons per day	31.4	40.6	75.9	93.4
Totals				
Populations	501,410	560,450	657,595	703,090
Tons per day	807.3	902.3	1058.7	1132.0

In the foregoing tabulations there are a few small differences in populations and amount of refuse collected per day. They are however, minor and have no effect on the capacities of the incinerator plants as given in this study.

6.3.3.4 Incinerator Plant Capacities

The required incinerator plant capacities for Districts A, B and C are based on the amounts of refuse given in the tabulation with the plants operating 16 hours per day. For District D the amounts of refuse are low and for quantities such as these it is preferable to provide for the burning of the refuse in an 8 hour day in order to reduce the operating costs as only one shift is required.

Based on the foregoing the required plant capacities for the years 1955 to 1980 inclusive would be as follows:

District A	1955	1960	1970	1980
Tons per day	285.7	319.8	373.1	396.8
Equivalent tons in 16 hrs.	429	480	561	596
Capacity tons per 24 hrs.	450	500	600	600
Number of units	2 or 3	2 or 3	3	3
Tons capacity each unit	200	200	200	200

District B	1955	1960	1970	1980
Tons per day	289.2	315.0	336.4	344.1
Equivalent tons in 16 hrs.	435	473	504	516
Capacity tons per 24 hrs.	450	500	600	600
Number of units	2 or 3	2 or 3	3	3
Tons capacity each unit	200	200	200	200

District C				
Tons per day	201.8	226.9	273.3	297.8
Equivalent tons in 16 hrs.	302	341	411	447
Capacity tons per 24 hrs.	325	350	450	450
Number of units	2 or 3	2 or 3	3	3
Tons capacity each unit	150	150	150	150

District D				
Tons per day	31.4	40.6	75.9	93.4
Equivalent tons in 8 hrs.	94	123	228	282
Capacity tons per 24 hrs.	100	130	250	300
Number of units	1	1	2	2
Tons capacity each unit	150	150	150	150

For comparative purposes this study is based on constructing full supplement of burning units as required for the year 1980.

6.4 ESTIMATED PLANT CONSTRUCTION COSTS

6.4.1 TOTAL FOR THREE SCHEMES

The estimated construction costs for Schemes A, B and C described in the foregoing outline are as follows:

6.4.1.1. Scheme A - Two Plants

District A - Plant AA

Plant Capacity 1,200 tons per 24 hours
Four 300 ton units

Incinerator Equipment	$1,800,000	
Trucking and Grading Equipment	25,000	
Structure	975,000	
Grading, Roadways, Fencing, Etc.	400,000	
Sub-Total for Plant AA		$3,200,000

Sub-Total for Plant AA brought forward		$3,200,000

District B - Plant AB

Plant capacity 600 tons per 24 hrs.
Three 200 ton units

Incinerator Equipment	$1,100,000	
Trucking and Grading Equipment	25,000	
Structure	575,000	
Grading, Roadways, Fencing, Etc.	225,000	
Sub-Total for Plant AB		$1,925,000
Construction Costs of Two Plants		$5,125,000
Land for two plants		25,000
Construction Contingencies		250,000
Engineering and Legal Costs		450,000
Bond Discount		250,000
TOTAL FOR SCHEME A		$6,100,000

6.4.1.2 Scheme B - Three Plants (Plants BA, BB & BC)

Capacity each plant 600 tons per 24 hrs.
Each plant three 200 ton units

Incinerator Equipment three plants	$3,300,000	
Trucking and Grading Equipment	75,000	
Structures, three plants	1,725,000	
Grading, Roadways, Fencing, etc.	675,000	
Construction costs of three plants		$5,775,000
Land for two plants		25,000
Purchase of Haverford Twp. plant & land		100,000
Construction Contingencies		280,000
Engineering and Legal Costs		520,000
Bond Discount		270,000
TOTAL FOR SCHEME B		$6,970,000
Taken as		7,000,000

6.4.1.3. Scheme C - Four Plants

Districts A & B - Plants CA, CB

Capacity each plant 600 tons per 24 hrs.
Each plant three 200 ton units

Incinerator Equipment-two plants	$2,200,000	
Trucking and Grading Equipment	50,000	
Structures two plants	1,150,000	
Grading, Roadways, Fencing, etc.	450,000	
Sub-Total for Plants CA & CB		$3,850,000

Sub-Total for Plants CA & CB brought forward	$3,850,000

District C - Plant CC

Plant capacity 450 tons per 24 hrs.
Three 150 ton units

Incinerator Equipment	$900,000	
Trucking and Grading Equipment	25,000	
Structure	525,000	
Grading,Roadways,Fencing,etc.	200,000	
Sub-Total for Plant CC		$1,650,000

District D - Plant CD

Plant capacity 300 tons per 24 hrs.
Two 150 ton units

Incinerator Equipment	$625,000	
Trucking and Grading Equipment	25,000	
Structure	350,000	
Grading,Roadways,Fencing,etc.	150,000	
Sub-Total for Plant CD		$1,150,000

Construction cost of four plants	$6,650,000
Land for three plants	40,000
Purchase of Haverford Twp. plant and land	100,000
Construction Contingencies	330,000
Engineering and Legal Costs	580,000
Bond Discount	300,000
TOTAL FOR SCHEME C	$8,000,000

6.4.1.4 Summary of Costs of the Three Schemes

Scheme A - Two Plants	$6,100,000
Scheme B - Three Plants	7,000,000
Scheme C - Four Plants	8,000,000

6.5 OPERATING COSTS

6.5.1 BASIS OF COSTS

Plant labor requirements are based on having 3 operators per unit and one maintenance man per unit, plus a superintendent and assistant superintendent and a weigh master at each incinerato plant. Power for plant operation has been taken as an average of

2 cents per kilowatt hour of current used. The labor and maintenance costs of two trucks for each plant has been provided for the hauling of the ash and clinker from the clinker storage bin to the dumping area, or for the direct dumping of the clinker into trucks and its haulage to the dumping area. The following costs are base on the year 1980 operating loads:

6.5.1.1. Scheme A - Two Plants

Plant AA - Four Units

Two shift operation (16 hrs. per day)

Operators	24 @ $5,000	$120,000	
Maintenance Men	4 @ 6,000	24,000	
Asst.Superintendent	1 @ 6,000	6,000	
Superintendent	1 @ 8,000	8,000	
Total Labor 30 men		$158,000	
Weigh Master		6,000	
Power		75,000	
Operation and maintenance of trucks		11,000	
Repairs and supplies		35,000	
Sub-Total for Plant AA			$285,000

Plant AB - Three Units

Two shift operation (16 hrs. per day)

Operators	18 @ $5,000	$ 90,000	
Maintenance Men	3 @ 6,000	18,000	
Asst.Superintendent	1 @ 6,000	6,000	
Superintendent	1 @ 8,000	8,000	
Total Labor 23 men		$122,000	
Weigh Master		6,000	
Power		49,000	
Operation & Maintenance of trucks		11,000	
Repairs and supplies		25,000	
Sub-Total for Plant AB			$213,000
TOTAL FOR SCHEME A			$498,000

6.5.1.2 Scheme B - Three Plants

Plants BA, BB and BC - Three units each
Two shift operation (16 hrs. per day)
Cost each plant:

Operators	18 @ $5,000	$ 90,000	
Maintenance Men	3 @ 6,000	18,000	
Asst.Superintendent	1 @ 6,000	6,000	
Superintendent	1 @ 8,000	8,000	
Total Labor 23 men		$122,000	
Weigh Master		6,000	
Power		49,000	
Operation & Maintenance of trucks		11,000	
Repairs and supplies		25,000	
Sub-Total for each plant		$213,000	
TOTAL FOR THREE PLANTS - SCHEME B			$639,000

6.5.1.3 Scheme C - Four Plants

Districts A & B - Plants CA & CB - Three Units Each

Two shift operation (16 hrs. per day)
Cost each plant:

Operators	18 @ $5,000	$ 90,000	
Maintenance Men	3 @ 6,000	18,000	
Asst.Superintendent	1 @ 6,000	6,000	
Superintendent	1 @ 8,000	8,000	
Total Labor 23 men		$122,000	
Weigh Master		6,000	
Power		49,000	
Operation & Maintenance of trucks		11,000	
Repairs and supplies		25,000	
Cost each plant		$213,000	
Sub-Total for Two Plants (CA & CB			$426,000

District C - Plant CC - Three Units

Two shift operation (16 hrs. per day)

Operators	18 @ $5,000	$ 90,000
Maintenance Men	3 @ 6,000	18,000
Asst.Superintendent	1 @ 6,000	6,000
Superintendent	1 @ 8,000	8,000
Total Labor 23 men		$122,000

Total Labor 23 men brought forward		$122,000	
Weigh Master		6,000	
Power		32,000	
Operation & Maintenance of trucks		11,000	
Repairs and supplies		20,000	
Sub-Total for Plant CC			$191,000

District D - Plant CD - Two Units

One shift operation (8 hrs. per day)

Operators	6 @ $5,000	$ 30,000	
Maintenance Men	2 @ 6,000	12,000	
Superintendent	1 @ 8,000	8,000	
Total Labor 9 men		$ 50,000	
Weigh Master		6,000	
Power		12,000	
Operation & Maintenance of truch		5,000	
Repairs and supplies		8,000	
Sub-Total for Plant CD			$ 81,000
TOTAL FOR FOUR PLANTS - SCHEME C			$698,000

6.5.1.4 Summary of Operating Costs -Three Schemes

Scheme A - Two Plants	$498,000
Scheme B - Three Plants	639,000
Scheme C - Four Plants	698,000

6.6 FIXED CHARGES

6.6.1 NEED FOR INCLUSION

Fixed charges, consisting of bond retirement and interest costs on the bond issue, form an integral part of the cost of the study covering the cost of refuse disposal by incineration and must therefore be included with the operating and maintenance costs to ascertain the final cost of each plan of disposal of refuse by incineration as the payment by the municipalities to the Delaware County Incinerator Authority must be such as to cover the costs of operation and maintenance and bond retirement and interest costs.

6.6.2 BOND RETIREMENT AND INTEREST COSTS

6.6.2.1 Bond Retirement Costs

For the purpose of this study it has been assumed the Authority would sell revenue bonds to finance the capital costs of the proposed incinerator plants. It has further been assumed that these will be of 25 years issue and will bear 4 per cent interest. To make a true comparison of costs requires the setting up of a debt amortization schedule for each plan of disposal. This necessitates a long tabulation of net revenue secured and its use for the paying of operation and maintenance costs, interest on the balances of the outstanding bonds, a cumulative interest reserve fund, improvement balances, amounts available for bond retirement and the amounts of the bonds balled for redemption over the 25 years life of the bond issue.

Rather than prepare such an elaborate schedule the average cost of bond retirement over the 25 year period has been used.

6.6.2.2 Interest Costs

The interest costs on the bond issue have been taken as an average of the interest payments during the life of the bond issue, that is it is based on one-half the cost of the bond issue, this being the average annual amount. Interest has been taken as 4 per cent and no allowance was made for redemption premiums.

6.6.3 COSTS FOR EACH SCHEME OF DISPOSAL

6.6.3.1 Scheme A - Two Plants

Amount of Bond Issue	$6,100,000	
Average annual cost of bond retirement		$244,000
Average annual interest costs		122,000
ANNUAL FIXED CHARGES SCHEME A		$366,000

6.6.3.2 Scheme B O Three Plants

Amount of bond issue	$7,000,000	
Average annual cost of bond retirement		$280,000
Average annual interest costs		140,000
ANNUAL FIXED CHARGES SCHEME B		$420,000

6.6.3.3 Scheme C - Four Plants

Amount of bond issue	$8,000,000	
Average annual cost of bond retirement		$320,000
Average annual interest costs		160,000
ANNUAL FIXED CHARGED SCHEME C		$480,000

6.7 TOTAL ANNUAL COSTS OF REFUSE INCINERATION

6.7.1 COSTS OF THREE SCHEMES

The total annual costs of refuse disposal by incineration of the three schemes are given in the following tabulation:

6.7.1.1. Scheme A - Two Plants

Operating and maintenance costs	$498,000	
Bond and interest costs	366,000	
TOTAL FOR SCHEME A		$864,000

6.7.1.2 Scheme B - Three Plants

Operating and maintenance costs	$639,000	
Bond and interest costs	420,000	
TOTAL FOR SCHEME B		$1,059,000

6.7.1.3 Scheme C - Four Plants

Operating and maintenance costs	$698,000	
Bond and interest costs	480,000	
TOTAL FOR SCHEME C		$1,178,000

6.7.2. INCINERATION COSTS PER TON

6.7.2.1 Comparative Quantities

The costs of refuse disposal for the county wide method of disposal by incineration of the refuse from all of the 49 municipalities in the county, are given in the following tabulation. These are for comparative purposes only as accurate calculations have not been made of the operating costs for labor and power during the earlier years of operation, when there are lesser quantities. The costs are, however, comparative for conditions obtaining in the year 1980 when the plants would be practically up to their rated capacities.

The amounts of refuse to be incinerated, as previously given in Chapter No. 4, Quantities of Refuse, are the totals for each year and are based on 800 pounds of refuse per capita per year. They are as follows:

	1955	1960	1970	1980
Tons per year	200,564	224,180	263,038	281,236

6.7.2.2 Comparative Costs

The cost per ton of refuse incinerated for the years 1955 to 1980 inclusive for the foregoing quantities would be about as follows:

SCHEME A - TWO PLANTS	1955	1960	1970	1980
Operating costs	$440,000	450,000	480,000	498,000
Fixed charges	366,000	366,000	366,000	366,000
Totals	$806,000	816,000	846,000	864,000
Costs Per Ton				
Operating costs	$2.19	$2.00	$1.82	$1.77
Fixed charges	1.82	1.63	1.39	1.30
Totals	$4.01	$3.63	$3.21	$3.07

Probable average cost per ton, years 1955 - 1980 $3.50

SCHEME B - THREE PLANTS	1955	1960	1970	1980
Operating costs	$570,000	580,000	610,000	639,000
Fixed charges	420,000	420,000	420,000	420,000
Totals	$990,000	1,000,000	1,030,000	1,059,000
Costs Per Ton				
Operating costs	$2.84	$2.58	$2.32	$2.27
Fixed charges	2.09	1.87	1.60	1.49
Totals	$4.93	$4.45	$3.93	$3.76

Probable average cost per ton, years 1955 - 1980 $4.30

SCHEME C - FOUR PLANTS				
Operating costs	$618,006	625,000	658,000	698,000
Fixed charges	480,000	480,000	480,000	480,000
Totals	$1,098,000	1,105,000	1,138,000	1,178,000
Cost Per Ton				
Operating costs	$3.09	$2.78	$2.50	$2.49
Fixed charges	2.39	2.14	1.82	1.71
Totals	$5.48	$4.92	$4.32	$4.20

Probable average cost per ton, years 1955 - 1980 $4.70

6.7.3.3. Comparative Per Ton Costs

The comparative average cost of refuse disposal by incineration for the three schemes are approximately as follows:

SCHEME A - TWO PLANTS - $3.50
SCHEME B - THREE PLANTS $4.30
SCHEME C - FOUR PLANTS $4.70

6.7.3 HAULING COSTS

6.7.3.1. A Component Part of Disposal Cost

In this study it is anticipated that each municipality in the county will haul its refuse to the sites of the incinerator plants. The lengths of haul involved in the three schemes of incinerator plant location and capacity are therefore a factor in the total annual cost of disposal by incineration for the county.

6.7.3.2 Studies Made

As there are three schemes of refuse disposal by incineration, studies were made to determine the approximate cost of refuse hauling for each of them. In the appendices to this report there are listed the road miles and the ton miles involved in each of the three schemes.

6.7.3.3 Hauling Costs

Hauling costs, as distinguished from collecting costs, vary considerably depending on the type of equipment used and the efficiency of operation. Investigations of these indicate they may vary between 15 and 25 cents per ton mile. Using an arbitrary cost of 20 cents per ton mile, for the year 1955 refuse quantities, the comparative hauling costs (not including costs of collection) are about as follows:

	Scheme A 2 Plants	Scheme B 3 Plants	Scheme C 4 Plants
Ton miles per year	975,468	771,762	730,689
Hauling Costs	195,093	154,332	146,138
Percent Over Scheme "C"	33	6	0

6.7.3.4 Combined Plant and Hauling Costs

Including hauling costs for the year 1955 with the plant operating costs and fixed charges as previously given, the total cost of hauling and disposal would be as follows:

	Scheme A 2 Plants	Scheme B 3 Plants	Scheme C 4 Plants
Operation & fixed costs	$ 806,000	$ 990,000	$1,098,000
Hauling costs from municipalities	195,093	154,332	146,138
Totals	$1,001,093	$1,144,332	$1,244,138
Percent increase over Scheme A	0	11.3	20.4

6.8 GENERAL COMMENTS

6.8.1 PRESENT USE OF METHOD

Incineration as a method of refuse disposal is a well established practice. The operating difficulties inherent in the older types of plants caused this method to be looked upon with some disfavor, particularly as the operating and maintenance costs were quite high. With the advent of contemporary types of plants, particularly the recently developed continuous traveling grate types, the method is now regaining its former popularity as a sanitary method of disposing of municipal refuse.

6.8.2 HANDLING OF FLY ASH AND PARTICULATE MATTER

One of the glaring disadvantages of the older types of incinerator plants was the belching of smoke, dust and burning matter from the plant chimneys. With the development and use of efficient flue gas scrubbers, this difficulty has been overcome. The only visible discharge is a water vapor which disappears immediately following its contact with the atmosphere.

6.8.3 APPLICABLE SCHEME

Should the refuse from the entire county be disposed of by incineration, either Scheme B, entailing the use of three plants or Scheme C, using four plants should be used, even though the total costs are 11.3 and 20.4 percent greater than for two plant scheme. The concentration of trucks at any one point is naturally less as more plants are used, and many municipalities would object to continuous and heavy trucking through their streets. This objection would be overcome to some extent by using a greater number of plants.

The studies indicate that at present it would not be necessary, or for that matter economical, to dispose of the refuse from the entire county by incineration. Because of this the study of incineration of the refuse for the entire county has been made to compare its cost with that of the alternate method of disposal, namely landfill operations.

CHAPTER 7

STUDIES OF LANDFILL

7.1 SITES OF LANDFILL

7.1.1 NUMBERS OF SITES

As mentioned under Chapter 6, Studies of Incineration, Delaware County has an area of some 185 square miles, with varying population densities. As for the incineration studies it is at once apparent that a single site for the landfill operation would from a cost of collection standpoint not be economically feasible. Further, it is not possible to find landfill areas with the same ease as it is to find sites for incinerator plants.

7.1.2 FEASIBILITY OF LANDFILL FOR COUNTY OPERATION

With the quantities of refuse to be disposed of in the county for the years 1955 to 1980 inclusive, it is not practical to consider landfill as an operation that would serve the entire county for these years. Not only is there not enough available land, but the locations of available sites are far removed from the more dense population centers which would entail prohibitive hauling costs for the more densely populated municipalities.

The study of landfill refuse disposal has been made for the county as a whole so that costs of this method of refuse disposal are available for comparison with refuse disposal by incineration for the entire county. Finally neither method of refuse disposal can be used in their entireties as the population densities in the county are such that both methods will have to be used.

7.1.3. AVAILABLE SITES

A survey was made of sites that might be available for landfill operations. In reviewing these it must be considered that Springton reservoir and its watershed area, are located in parts of Newtown, Marple and Upper Providence Townships. This prohibits landfill operations in any parts of these townships, in which the drainage areas slope toward the reservoir. Likewise the dam for water supply for Media Borough is on Ridley Creek, just west of the borough. This again prohibits using landfill in the Ridley Creek watershed area above the dam. Realty development in the Radnor, Haverford, Newtown and Marple Townships, in the northerly part of the county, are such that there are no sites available for landfill in these townships. With the exception of the swamp areas in Tinicum Township and swamp lands bordering Darby Creek in Folcroft, Norwood, Prospect Park and Ridley Park Boroughs, there are no available landfill sites in the southeastern parts of the county.

This leaves the westerly part of the county and the swamp areas previously mentioned as being the only parts of the county available for landfill operations. A careful consideration of these areas indicates that landfill operations could be conducted in the swamp lands of Tinicum Township and the swamp lands adjoining Darby Creek. These would be of the dike and fill type. Also landfill operations of the trench or area method could be conducted in the parts of the western section of the county in the presently sparsely settled Edgmont, Thornbury, Concord and

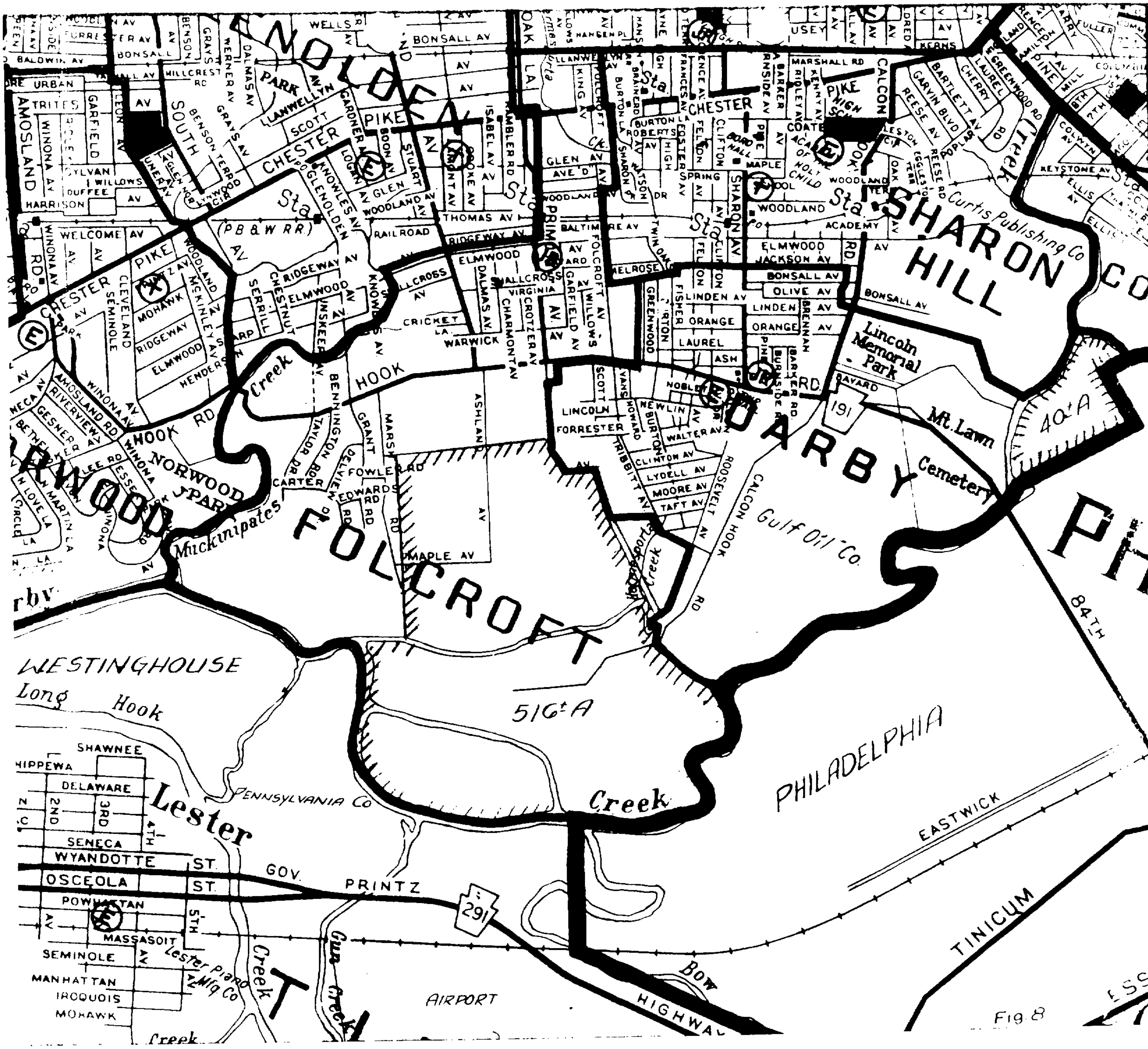

FOLCROFT
DARBY
SHARON HILL
NORWOOD PARK
PHILADELPHIA
WESTINGHOUSE
Long Hook
Lester
Pennsylvania Co
Gulf Oil Co.
Lincoln Memorial Park
Mt. Lawn Cemetery
Curtis Publishing Co
Muckinipates Creek
Darby Creek
516± A
40± A
GOV. PRINTZ
HIGHWAY
291
AIRPORT
EASTWICK
TINICUM
Lester Piano Mfg Co
CHESTER PIKE
HOOK RD
ELMWOOD
WYANDOTTE ST.
OSCEOLA ST.
SENECA
DELAWARE
SHAWNEE
SEMINOLE
MANHATTAN
IROQUOIS
MOHAWK
MASSASOIT
84TH

Fig. 8

Birmingham Townships. Investigations were not made as to whether or not any of the possible landfill operations would be welcomed by these boroughs and townships, but for the purpose of the study it was assumed that if the landfill method was adopted, the sites required therefore could be made available.

7.1.4. SITES USED IN STUDY

In this study it was assumed that landfill operations could be made in the swamp lands of Tinicum Township and in two sites situated in Edgmont and Concord Townships.

7.2. OUTLINE OF POPULATIONS SERVED AND CAPACITIES OF SITES

7.2.1. DIVISION OF POPULATIONS

In this study it has been assumed that Crum Creek would in general form the dividing line for refuse disposal by landfill to the two sites. On this basis the populations to be served and the amounts of refuse to be disposed of would for the area east of Crum Creek be the same as that outlined for incinerator plants BA and BB of Plan B, Three Incinerator Plants and that from the area west of Crum Creek would be the same as for Incinerator Plant BC.

7.2.2. AMOUNTS OF REFUSE

The refuse from the populations east of Crum Creek would in general be hauled to the swamp lands in Tinicum Township and the adjoining swamp lands and that from the populations west of Crum Creek would in general be hauled to landfill operations in Edgmont and Concord Townships. These are indicated as Sites A and B respectively. The populations and amounts of refuse in tons per day contributory to the two areas would then be as follows:

	1955	1960	1970	1980
Site A - Tinicum Township				
Populations	357,110	394,280	440,695	460,140
Tons avg.per day	464.2	517.6	577.9	598.2
Site B - Edgmont or Concord Township				
Populations	144,300	166,170	216,900	242,950
Tons avg.per day	187.6	216.0	287.0	315.9
Totals				
Populations	501,410	560,450	657,595	703,090
Tons per day	651.8	733.6	864.9	914.1

7.3. REQUIREMENTS FOR SITE A - TINICUM TOWNSHIP

7.3.1. TYPE REQUIRED

At this site the landfill operations would be of the so called "wet" type.

7.3.1.1. Dikes and Lagoons

The landfill operations would be in swamp lands subjected in parts to the effects of tide water. This requires outshore dikes to prevent the inflow of water to the fill area. Drainage culverts must be provided in the dikes. The discharge ends of culverts must be equipped with easily cleanable trash or bar screens and tide gates to prevent the inflow of water. The area should be sub-divided into lagoons, formed by dikes, for better control of operations, with filling limited to one lagoon at a time. Noisome leaching through the dikes may require the use of shallow wood sheet piling. Heavy chlorination of the effluent from the dikes may also be necessary to prevent pollution of the receiving waters.

7.3.1.2. Placing of Refuse

The initial dumping in water of refuse in each lagoon should be made during the cold winter months to a compacted elevation of about two feet above maximum high water. After this is placed it should be fully compacted and covered with a layer of earth. Subsequent placing of the refuse could then be continued, with each layer covered with 6 to 12 inches of earth. The final cover on the completed fill should have a compacted depth of not less than two feet as a permanent rodent and insect control. The final cover material and that used in the intermediate covering should be clean earth, relatively free of organic matter, tree roots or branches, large stones, bulky waste building materials and if possible with a clay content of not more than 50 percent. These limitations are required to assure good all weather tractions, to safeguard against unequal settlement and heaving action, to discourage burrowing by rodents, to thoroughly blanket the putrescible materials in the refuse and to reduce surface cracking

7.3.1.3. Other Facilities

Semi-portable sheds must be located near the entrance to the landfill operations to house the operating staff and labor. This housing must have heat, water, sewerage facilities, lighting, lockers and showers. An adjoining semi-portable type weigh room with truck scale is reouired to weigh the refuse materials as delivered by each municipality. Hard surface roadways of semi-permanent construction must be built from the point of entry to the dumping points.

There is also required the stockpiling of cover materials in sufficient quantity to at least last through the winter operation. This material must be brought in from a source outside Tinicum Township, as it cannot be secured from within the township. This would entail considerable lengths of haul with consequent high costs.

7.3.1.4. Equipment Required

The type and number of pieces of equipment may vary to a certain extent, but for the previously given amounts of refuse to be disposed of, the following is probably typical of that which would be required.

A - Three 20 ton bull dozers, diesel engine driven, crawler or pneumatic tire type. Two of these would be required at the active areas for pushing and distributing the truck piled refuse over the banks and the third for miscellaneous grading, covering, road building, etc. and as a standby unit.

B - Three 15 cubic yard self loading, self dumping scrapers, each tractor drawn. They would be required to dig and carry covered material from the stockpile to the dumping areas and for the continuous spreading and coverage of freshly placed refuse.

C - One street flusher or its equivalent for spraying deodorants and for fighting fires.

7.4. REQUIREMENTS FOR SITE B - EDGMONT OR CONCORD TOWNSHIP

7.4.1. TYPE REQUIRED

The trench or the area method of landfill would be used at either of these sites.

7.4.1.1. Housing and Roadways

Semi-portable sheds, weigh rooms, roadways would be required at these sites as described for Site A, Tinicum Township.

7.4.1.2. Equipment Required

At either of these sites two bull dozers, two scrapers would be required, together with one street flusher.

7.5. AREAS REQUIRED

7.5.1. SIDE A - TINICUM TOWNSHIP

At this site the refuse would first be placed to a point about two feet above maximum high water, which would be an average refuse fill depth of about five feet. Subsequent layers should be placed at depths varying between two and three feet between cover materials, with the fill carried up to a combined depth of about 12 feet. For this depth and a compaction ratio of 3 to 1, the area required would be about one acre per 12,000 population and the required areas for the years 1955 to 1980 inclusive would be about as follows:

Year	Population	Acres per Year	Total Area in Acres Increment	Total
1955	357,110	30	---	---
1960	394,280	32.2	160	160
1970	440,695	36.8	368	528
1980	460,140	38.4	384	912

7.5.2. SITE B - EDGMONT OR CONCORD TOWNSHIP

At either of these sites refuse and cover materials would be placed to a total depth of about 9 feet. On this basis about one acre would be required per year per 10,000 population and the required areas would be about as follows:

Year	Population	Acres per year	Total area in Acres Increment	Total
1955	144,300	14.4	---	---
1960	166,170	16.6	83	83
1970	216,900	21.7	217	300
1980	242,950	24.4	244	544

7.6. COST OF LANDFILL

7.6.1. COST OF ACADEMIC INTEREST

While the question of the cost of landfill disposal of refuse may be academic for the county as a whole, it has been included in this study to compare it with refuse disposal by incineration for the county as a whole.

7.6.2. CAPITAL COSTS

7.6.2.1. Work Included

The capital costs of disposal by landfill consists of the various structures, the equipment and the roadways required at the two sites, together with the dikes with their drainage facilities for the Tinicum Township site.

7.6.2.2. Site A - Tinicum Township

The capital cost of this site has been based on the eventual (1980) cost for the preparation and use of the area. For the purpose of this estimate the total area of 900 acres would be divided into about 90 lagoons each having an area of 10 acres or 435,600 square feet and a size of about 500 feet by 860 feet. Each lagoon would have one or more culverts with screens and tide gates. The estimated cost also includes semi-permanent personnel buildings, a truck scale and weigh masters structures, two sets being required during the life of the landfill operation. It has been assumed that during the some 25 years of operation the wear and tear on the bull dozers and scrapers would require three renewals in addition to the initial equipment.

On this basis the total capital cost of the landfill operatio at this site will be about as follows:

Preparation of dikes 500,000 c.y.	$1,500,000.00
Bull dozers and scrapers (4 sets)	1,000,000.00
Culverts, screens and gates	250,000.00
Operating and weighing buildings	150,000.00
Trash fencing, etc.	100,000.00
Total construction cost	$3,000,000.00
Construction Contingencies	150,000.00
Engineering and legal costs	270,000.00
Total capital cost	$3,420,000.00
Taken as	$3,500,000.00

7.6.2.3. Site B - Edgmont or Concord Township

The capital cost of this site has again been based on the eventual (1980) cost of this site. This includes four purchases of bull dozers and scrapers and two sets of buildings for the operating personnel and the weigh master.

On this basis the total capital cost of the landfill for this site would be about as follows:

Bull dozers, scrapers, etc.	$ 700,000.00
Operating and weighing buildings	150,000.00
Trash fencing, etc.	50,000.00
Total construction cost	$ 900,000.00
Construction Contingencies	50,000.00
Engineering and legal costs	80,000.00
Total capital cost	$1,030,000.00
Taken as	$1,100,000.00

7.6.2.4. Total Capital Cost of Landfill

Based on the foregoing the eventual total capital costs for landfill operations would be about as follows:

Site A - Tinicum Township	$3,500,000.00
Site B - Edgmont or Concord Townships	1,100,000.00
Total capital cost	$4,600,000.00

The cost of land has not been included in the capital costs for the two sites as it has been assumed that the possible improvement to the sites would be such that the municipalities would allow the landfill operation to be done without charging for the land.

7.6.3. OPERATING COSTS

7.6.3.1. Costs Included

The component parts of the operating costs include the personnels at the sites and the weigh master, the operation and maintenance of the bull dozers and scrapers and the hauling in of earth material for cover at the Tinicum site. The amount of cover required, based on a total of 2.7 feet for intermediate and final covers, increases as the population increases, but for the purpose of this estimate the total required has been divided in equal amounts for each year between 1955 and 1980. During this period there will be required about 4,000,000 tons of earth cover or about 160,000 tons per year. It has been assumed at the Edgmont or Concord site that the earth required for cover could be secured from the trenching operation.

7.6.3.2. Site A - Tinicum Township

Equipment operators (1 shift)	8 @ $6,250.	$50,000.	
Men on spreading "	3 @ 5,000.	15,000.	
Superintendant "	1 @ 8,000.	8,000.	
Total Labor			$73,000.
Weigh Master			6,000.
Equipment fuel and maintenance			29,000.
Cover materials 160,000 tons	@ $3.00		480,000.
Heat, light, etc.			2,000.
Deodorants, chlorination, etc.			9,000.
Total average operating cost			$599,000.

7.6.3.3. Site B - Edgmont or Concord Township

Equipment operators (1 shift)	6 @ $6,250.	$37,500.	
Men on spreading "	2 @ 5,000.	10,000.	
Superintendant	1 @ 8,000.	8,000.	
Total Labor			$ 55,500.
Weigh Master			6,000.
Equipment fuel and maintenance			20,500.
Heat, light etc.			2,000.
Deodorants, etc.			2,000.
Total average operating cost			$86,000.

7.6.3.4. Total Operating Cost

Based on the foregoing the total operating cost would be as follows:

Site A - Tinicum Township	$599,000.
Site B - Edgmont or Concord Township	86,000.
Total operating cost	$685,000.

7.7. FIXED CHARGES

7.7.1. NEED FOR INCLUSION

Fixed charges, consisting of bond retirement and interest costs on the bond issue, form an integral part of the cost of study covering cost of refuse disposal by landfill and must therefore be included with the operating and maintenance cost to ascertain the final cost of each method of refuse disposal as the payment by municipalities to the Authority must be such as to cover the costs of operation and maintenance and the bond retirement and interest costs.

7.7.2. BOND RETIREMENT AND INTEREST COSTS

7.7.2.1. Bond Retirement Costs

As stated in Chapter 6, Disposal of Refuse By Incineration, it has been assumed in this study the Authority would sell revenue bonds to finance the capital costs of the landfill operations. With this method of disposal the full issue would not have to be sold at the beginning of the work as the capital expenditure would not be made at one time, but probably in several succeeding issues. Rather than setting up a series of costs for such issues this study has been based on the sale of a single issue at the beginning of the project. The cost of bond retirement has been based on the average cost of retirement over 25 year bond period.

7.7.2.2. Interest Costs

The interest costs on the bond issue has been taken as an average of the interest payments during the life of the bond issue, that is it is based on one-half the cost of the bond issue, this being the average annual amount. Interest has been taken at 4 percent.

7.7.2.3. Total Bond and Interest Costs

Amount of Bond Issue	$4,600,000.	
Average Annual bond retirement		$184,000.
Average Annual interest cost		92,000.
Annual fixed charges		$276,000.

7.8. TOTAL ANNUAL COST OF REFUSE DISPOSAL BY LANDFILL

7.8.1. COST COMPONENTS

The total annual cost of refuse disposal consists of the fixed and operating charges. Based on the foregoing these are as follows:

Operating and maintenance costs	$685,000.
Fixed Charges	276,000.
Total	$961,000.

7.8.2. DISPOSAL COSTS PER TON

7.8.2.1. Comparative Quantities

The costs of refuse disposal for the county wide method of disposal by landfill of the refuse from all of the 49 municipalities in the county, are given in the following tabulation. These are for comparative purposes only as accurate calculations have not been made of the operating costs during the earlier years of operation, when there are lesser quantities. These costs are however comparative with incineration costs for conditions obtaining during the year 1980.

The amounts of refuse to be disposed of by landfill are, as previously given as follows:

	1955	1960	1970	1980
Tons per day	651.8	733.6	865.9	914.1
Tons per year (300 days)	195,600	220,200	249,800	274,500

7.8.2.2. Costs of Disposal

The cost per ton of refuse disposed by landfill for the years 1955 to 1980 inclusive, would be about as follows:

	1960	1970	1980	Probable Average
Tons per year	220,200	249,800	274,500	250,000
Total Costs				
Operation	$625,000	$688,000	$709,000	$685,000
Fixed Charges	270,000	270,000	270,000	270,000
	$895,000	$958,000	$979,000	$955,000
Costs per Ton				
Operation	$ 2.84	$ 2.75	$ 2.57	$ 2.74
Fixed Charges	1.22	1.08	0.98	1.08
Totals	$ 4.06	$ 3.83	$ 3.55	$ 3.82

7.8.2.3. Costs Based on Prefilling of Tinicum Site

The foregoing high costs of refuse disposal by landfill are caused entirely by the necessity of having to haul earth cover materials for the Tinicum Township site from sources outside the Township. If the U. S. Army Engineers pump dredged river bottom sand and mud over the landfill area the operating cost would be materially reduced. Should dredge fill be provided for the Tinicum Site, to bring the ground level to above high water, the cost of disposal by landfill, the costs of the dikes, culverts, screens, etc. would reduce the total capital cost to about $1,750,000.00. Landfill at this site would then be of the trench method. This would cut the fixed charges in half and would reduce the operating expenses by eliminating the cost of hauling earth cover materials to the landfill site. On this basis the cost of landfill operation would be about as follows:

	1960	1970	1980	Probable Average
Tons per year	220,200	249,800	274,500	250,000
Total Costs				
Operation	$195,000	$205,000	$215,000	$205,000
Fixed Charges	135,000	135,000	135,000	135,000
	$330,000	$340,000	$350,000	$340,000
Costs per Ton				
Operation	$ 0.88	$ 0.82	$ 0.75	$ 0.82
Fixed Charges	0.61	0.54	0.49	0.54
Totals	$1.49	$1.36	$1.24	$1.36

7.8.2.4. Comparisons With Other Operations

New York City has widely practiced the use of refuse for filling in of swampy and tidal areas. As reported in the December 1955 issue of Public Works site preparation for two areas were $1,078,000. and $2,099,500., and 2,173,000 and 2,504,000 tons respectively of refuse were placed in these areas. Cover materials were taken from nearby points. The total costs per ton (excluding interest and capital, costs of utilities and administration) were $1.72 and $2.12 per ton respectively.

At other locations reported costs of landfill operations vary from $0.50 to $1.50 per ton. In California where landfill operations have been widely practiced the disposal costs were reported for the years 1950 and 1951 to be as follows:

Berkeley	$0.31	Palo Alto	$1.57
Fresno	0.33	Riverside	0.53
Oroville	1.28	Stockton	0.66

7.9. GENERAL COMMENTS

7.9.1. LARGE AREAS REQUIRED

Lands in which refuse landfills are placed are generally relegated to parks and playgrounds. For the large areas involved for the county wide use of landfill, being more than two square miles, this would not be practical. In Tinicum Township reclaimed land would probably have to be used as industrial sites.

7.9.2. SETTLEMENT OF LOADINGS

Usual practice in landfill operations generally calls for initial compacted grades to be about one-third higher than those ultimately required. Subsequent annual settlement will average about 15 percent the first year, about 6 percent the second year and about 3 percent for the next 2 to 4 years. This means that it will be not less than 6 years before the fill has become reasonably stabilized. Well seasoned refuse fills, placed in wet areas, will generally support loadings of about one ton per square foot. Any industrial plants constructed over the landfills in wet areas would require pile foundations.

7.9.3. INCREASED HAULING COSTS

As stated in Chapter 6, Studies of Refuse Incineration, hauling costs form a material component of the costs of refuse disposal for the 49 municipalities. Being generally far removed from the sources of refuse collection the cost of hauling would be greatly increased for municipalities in the northern part of the county. Based on studies made of hauling costs for the refuse incineration studies it is indicated that hauling costs for landfill operations would average from 30 to 50 percent more than for the more strategically located incinerator plants.

7.9.4. COMPARISON WITH INCINERATION COSTS

Assuming that the necessary land for the landfill operations would be available at the two sites the total comparative costs per ton would be about as follows:

	1960	1970	1980	Probable Average
Landfill	$4.06	$3.83	$3.55	$3.82
Incineration				
Scheme A	3.63	3.21	3.07	3.50
Scheme B	4.45	3.92	3.76	4.30
Scheme C	4.92	4.32	4.20	4.70

Should the Tinicum Township site be filled with pump dredged river bottom sand and mud the total landfill cost per ton would be as follows:

Landfill	$1.49	$1.36	$1.24	$1.36

This would be quite a reduction in the cost per ton of refuse disposed by landfill. However, most of the swamp lands in Tinicum Township are owned by the industries and would in all probability not be made available for landfill operations and if it was made available the costs would be those given for landfill in swamp areas. Due to the complexity of this operation the cost of landfill would be approximately the same as for incineration.

7.9.5. USE OF LANDFILL IN DELAWARE COUNTY

A careful consideration of all facts pertaining to the landfill method of refuse disposal indicates that it would not be practical for county wide use and that incineration of the refuse should be the method to be adopted.

It must, however, be used until the incinerator plants are constructed to dispose of the refuse from municipalities which shortly may have no means for properly disposing of their refuse. This is covered in the following Chapter No. 8, Recommended Methods of Disposal.

CHAPTER NO. 8

RECOMMENDED METHODS OF DISPOSAL

8.1. DIVISION OF COUNTY BY POPULATION DENSITIES

In Figure No. 2, Population Distributions in the year 1950, revised as of 1955, it shows that the more highly populated areas are those in the easterly and southerly parts of the county, the greater densities being in Upper Darby Township, Darby Borough, Haverford Township, Lansdowne Borough, Yeadon Borough, Ridley Township, Springfield Township and the City of Chester. The 1955 population in these was about 300,000 or about 60 percent of the entire county. With the exception of Radnor Township the northerly and westerly parts are relatively sparsely settled, particularly the westerly parts.

8.2. SERVICING OF COUNTY

In view of the foregoing and the fact that disposal by landfill would only be a temporary measure, refuse from the more densely populated parts of the county should be disposed of by incineration. For this, either of Schemes A or B, two and three incinerator plants respectively, could be used. It is indicated that Scheme C, the four plant scheme of incineration, would not be economical at this time due to the sparsely settled area the fourth plant would serve. For the sparsely settled areas, landfill operations could be used if so desired by the municipalities comprising these areas.

Of Schemes A and B, Scheme B, the three plant project, described in Chapter No. 6, Studies of Incineration, is

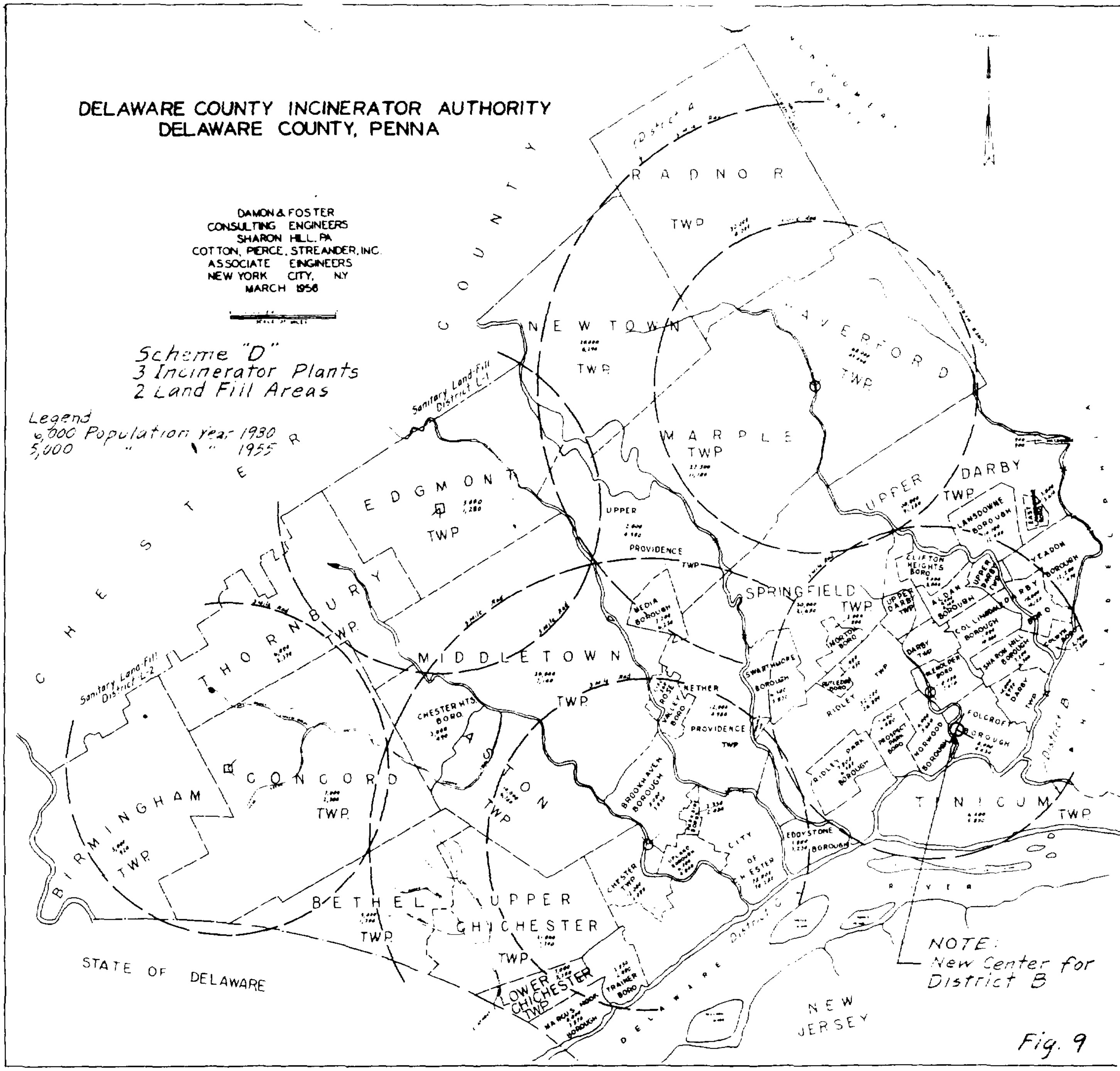
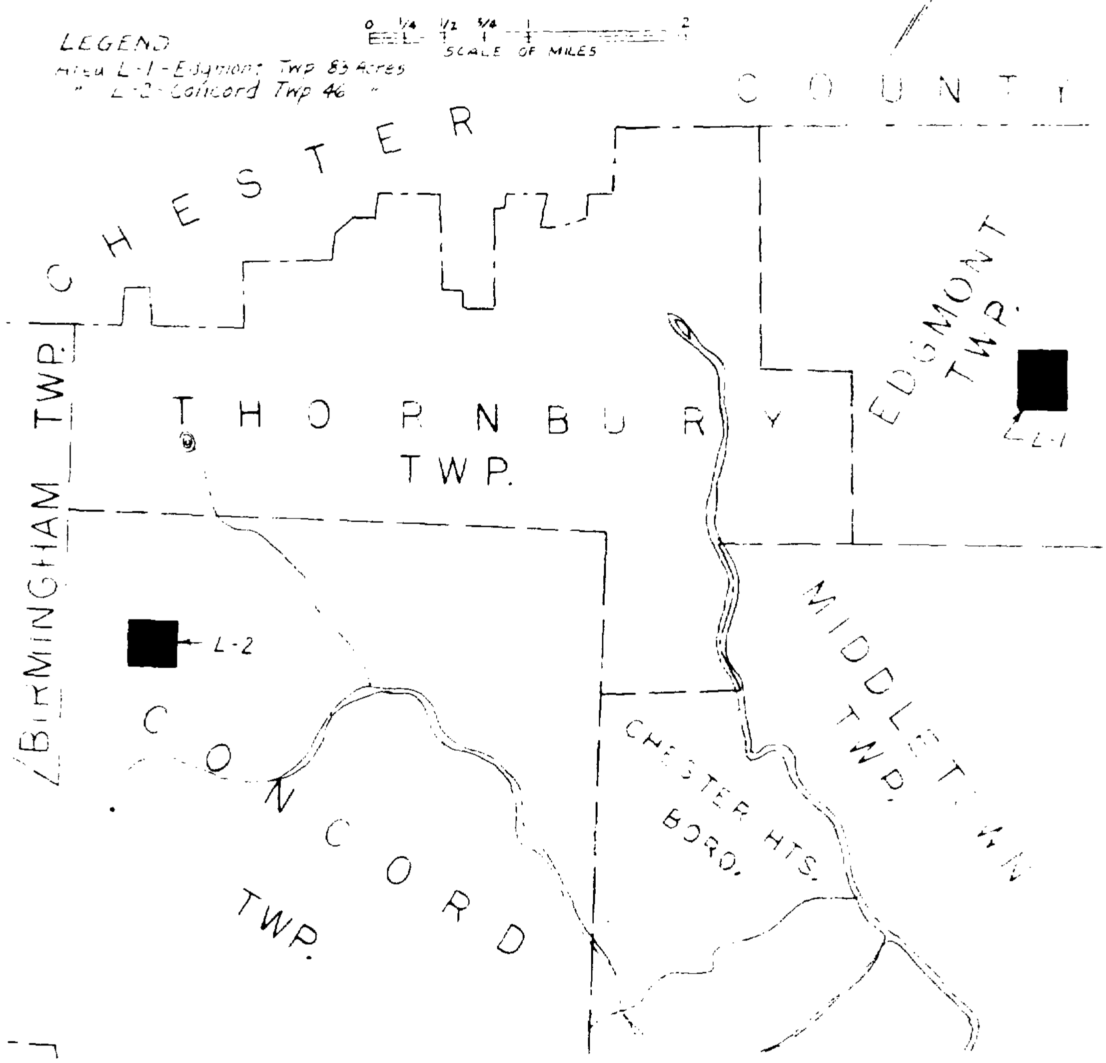
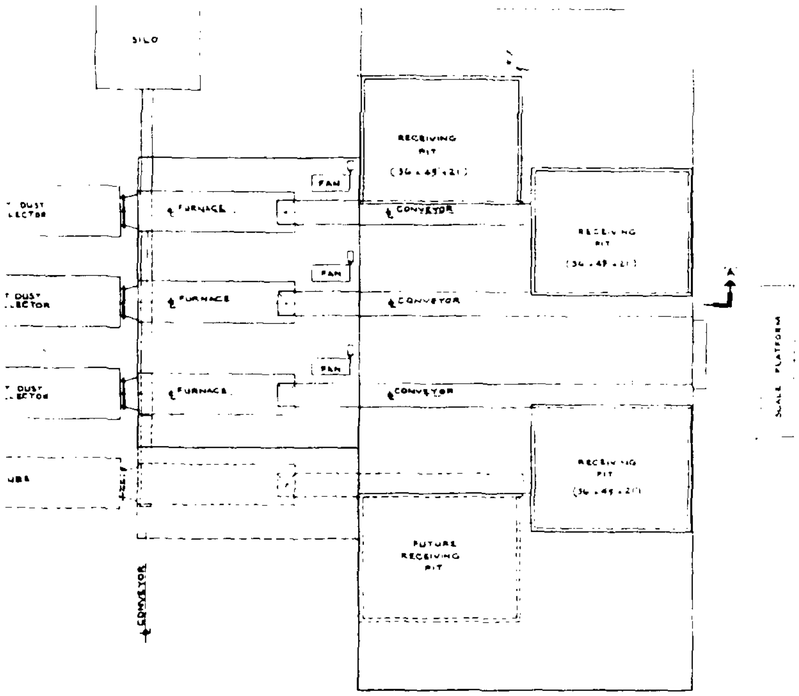

DELAWARE COUNTY INCINERATOR AUTHORITY
DELAWARE COUNTY, PENNA
DAMON & FOSTER
CONSULTING ENGINEERS
SHARON HILL, PA
COTTON, PIERCE, STREANDER, INC.
ASSOCIATE ENGINEERS
NEW YORK CITY, NY
MARCH 1956
Scheme "D"
3 Incinerator Plants
2 Land Fill Areas
Legend
6,000 Population year 1930
5,000 " " 1955
CHESTER COUNTY
RADNOR TWP
NEWTOWN TWP
HAVERFORD TWP
MARPLE TWP
EDGMONT TWP
UPPER PROVIDENCE TWP
UPPER DARBY TWP
SPRINGFIELD TWP
THORNBURY TWP
MIDDLETOWN TWP
CONCORD TWP
BIRMINGHAM TWP
ASTON TWP
BETHEL TWP
UPPER CHICHESTER TWP
LOWER CHICHESTER TWP
NETHER PROVIDENCE TWP
RIDLEY TWP
TINICUM TWP
CITY OF CHESTER
CHESTER TWP
EDDYSTONE BOROUGH
MEDIA BOROUGH
SWARTHMORE BOROUGH
CHESTER HTS. BORO
TRAINER BORO
MARCUS HOOK BOROUGH
LANSDOWNE BOROUGH
YEADON BOROUGH
DARBY BOROUGH
FOLCROFT BOROUGH
NORWOOD BOROUGH
Sanitary Land-Fill District L-1
Sanitary Land-Fill District L-2
District A
District B
District C
STATE OF DELAWARE
DELAWARE RIVER
NEW JERSEY
NOTE:
New Center for District B

Fig. 9

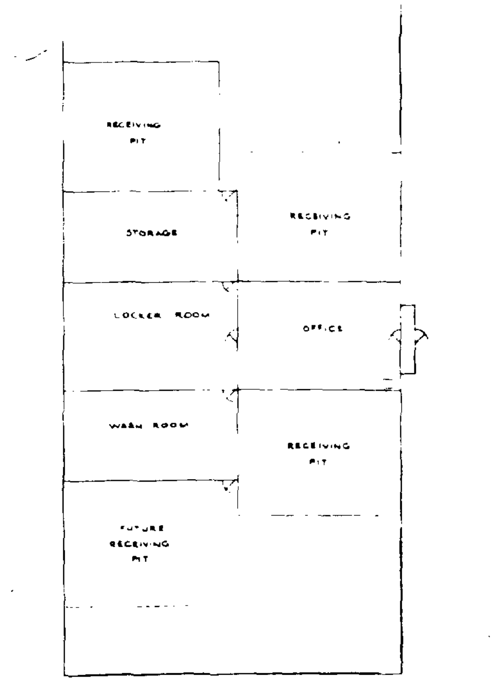
DELAWARE COUNTY INCINERATOR AUTHORITY
DELAWARE COUNTY, PENNA.

Damon & Foster
Consulting Engineers
Sharon Hill, Pa.
Cotton, Pierce, Streander, Inc.
Associate Engineers
New York City, N.Y.
March 1956

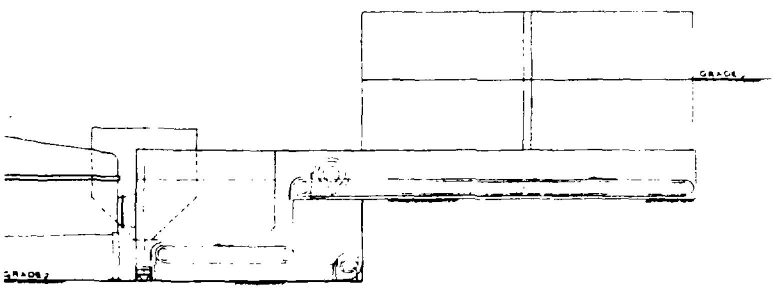




PLAN
EQUIPMENT LAYOUT



FLOOR PLAN



ELEVATION 'A-A'

Fig. 10

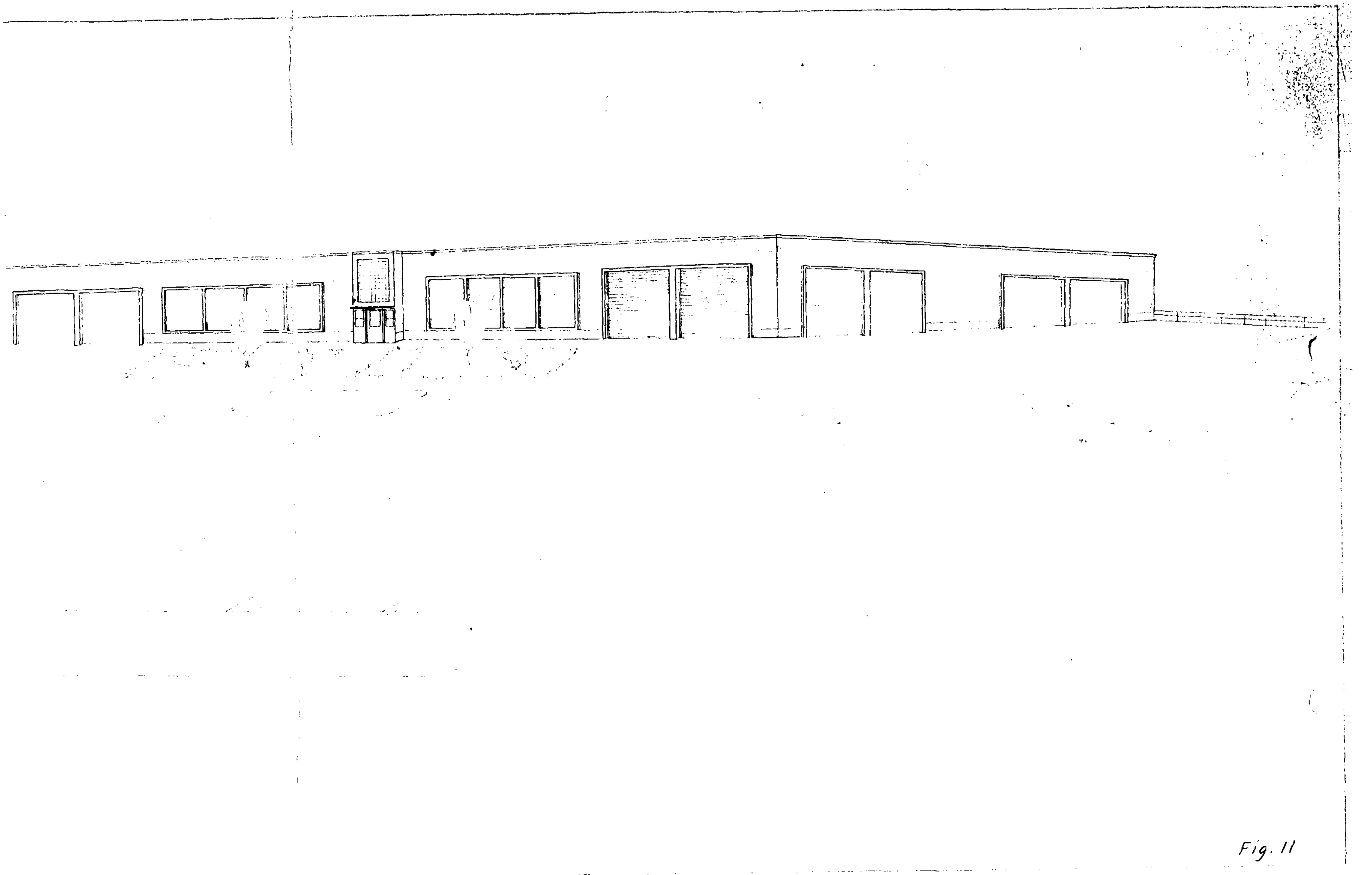


Fig. 11

recommended. Plants BA and BB would serve the same population described in Chapter No. 6, but Plant BC would be changed because of allocating certain of the municipalities to landfill operation. Landfill operations are referred to in the following discussion as areas L1 and L2. The recommended scheme of refuse disposal is referred to herein as Scheme D. The locations of the proposed incinerator districts and the landfill areas are shown on Figure No. 9.

8.3. INCINERATION PLANTS - SCHEME D.

8.3.1. TYPE OF PLANTS

The types of incinerator plants covered in this report are those referred to as the continuous feed, traveling grate, constant temperature type, having an efficient system for the control of flue dust and particulate matter. These were described in detail under Section 5.6., Refuse Incinerators of Chapter No. 5, Methods of Refuse Disposal, and in Chapter No. 6, Studies of Incineration. The general arrangement of a typical incinerator plant is shown on Figure No. 10 and a perspective showing its general appearance is shown on Figure No. 11.

8.3.2. POPULATIONS SERVED AND PROPOSED PLANT CAPACITIES

Under Scheme D, the recommended method of refuse disposal, it is proposed to construct the three incinerator plants at the locations shown in Figure No. 9, with three districts namely A, B and C. Plants for Districts A and B would be at the locations described in Chapter No. 6, Studies of Incineration, and that for District C, would be located just south of where Bridgewater Road crosses Chester Creek. It is to be noted that parts of the populations previously given for these districts in Chapter No. 6, Studies of Incineration, have been included under landfill operations due to the sparse population densities obtaining in the outlying areas of these districts.

The municipalities included in each district and their populations for the years 1955 to 1980 inclusive are given in the following tabulations:

Population - District A

	1955	1960	1970	1980
Haverford Township	49,460	55,000	64,000	68,000
Marple Township	11,180	15,600	22,000	27,500
Millbourne Borough	900	910	925	940
Newtown Township	2,290	4,800	6,600	6,000
Radnor Township	18,370	22,000	28,200	30,000
Upper Darby Township	91,280	94,300	98,000	100,000
Totals	173,480	192,610	219,725	232,440

Populations - District B

	1955	1960	1970	1980
Aldan Borough	4,140	4,400	4,790	4,900
Clifton Heights Borough	8,040	8,400	8,900	9,000
Collingdale Borough	10,000	10,700	10,900	11,000
Colwyn Borough	2,200	2,300	2,460	2,700
Darby Borough	14,120	14,600	14,800	15,000
Darby Township	9,990	11,900	13,600	14,000
East Lansdowne Borough	3,610	3,700	3,700	3,800
Eddystone Borough	3,230	3,400	3,600	3,800
Folcroft Borough	4,430	5,700	7,300	8,000
Glenolden Borough	7,410	8,000	8,350	8,400
Lansdowne Borough	12,940	13,600	14,000	14,100
Morton Borough	1,800	1,900	1,950	2,000
Norwood Borough	5,660	5,840	5,920	6,000
Prospect Park Borough	6,480	7,000	7,500	7,600
Ridley Township	26,800	30,000	31,400	32,000
Ridley Park Borough	6,580	7,400	7,760	7,800
Rutledge Borough	950	960	980	1,000
Sharon Hill Borough	6,500	7,000	7,500	7,700
Springfield Township	21,650	25,400	28,800	30,000
Swarthmore Borough	5,830	6,120	6,250	6,300
Tinicum Township	5,800	5,900	6,350	6,400
Yeadon Borough	11,470	11,450	12,100	12,200
Totals	179,630	195,670	208,970	213,700

Populations - District C

	1955	1960	1970	1980
Aston Township	6,740	8,350	11,000	14,000
Brookhaven Borough	3,030	4,100	6,000	8,000
Chester City	70,280	73,500	76,500	78,000
Chester Township	4,080	6,250	11,350	12,000
Lower Chichester Township	3,350	3,950	5,160	7,000
Marcus Hook Borough	3,870	3,870	3,950	4,000
Media Borough	6,250	6,800	7,000	7,200
Middletown Township	5,140	5,700	11,850	12,000
Nether Providence Township	8,220	12,500	15,300	16,000
Parkside Borough	2,080	2,230	2,300	2,350
Rose Valley Borough	560	620	990	1,150
Trainer Borough	2,080	2,200	2,600	2,850
Upland Borough	4,840	5,200	6,000	6,400
Upper Chichester Township	7,740	9,050	18,000	21,000
Totals	128,260	144,320	178,000	191,950

8.3.3. POPULATION AND REFUSE FOR EACH DISTRICT

The total population included for incineration of the refuse would be the totals of the foregoing districts. These and the average daily and peak day amounts of refuse would be as follows:

	1955	1960	1970	1980
District A				
Populations	173,480	192,610	219,725	232,440
Average tons per day	225.6	250.4	285.6	302.2
Peak tons per day	279.3	310.1	353.8	374.2
District B				
Populations	179,630	195,670	208,920	213,700
Average tons per day	233.5	254.4	271.6	277.8
Peak tons per day	289.2	315.9	336.0	344.1
District C				
Populations	128,260	144,320	178,000	191,950
Average tons per day	166.7	187.6	231.4	249.5
Peak tons per day	206.4	232.4	286.6	309.0
Totals				
Populations	481,370	532,600	606,695	638,090
Average tons per day	625.8	692.4	788.6	929.5
Peak tons per day	774.9	857.5	977.3	1027.3

8.3.4. INCINERATOR PLANT CAPACITIES

Based on the foregoing populations and amounts of refuse, the amounts of refuse to be burned for the peak day collections in an operating period of 16 hours (2 operating shifts), would require the following plant capacities for the years 1955 to 1980 inclusive.

	1955	1960	1970	1980
District A				
Peak tons per day	279.3	310.1	353.8	374.2
Equivalent tons in 16 hours	419.0	465.2	530.7	561.3
Capacity per 24 hours	450	600	600	600
Number of units	---	3	3	3
Tons capacity each unit	---	200	200	200
District B				
Peak tons per day	289.2	315.0	336.9	344.1
Equivalent tons in 16 hours	433.8	472.5	505.4	516.2
Capacity per 24 hours	450	600	600	600
Number of units	---	3	3	3
Tons capacity each unit	---	200	200	200
District C				
Peak tons per day	206.4	232.4	285.6	309.0
Equivalent tons in 16 hours	309.6	348.6	429.9	463.5
Capacity per 24 hours	400	400	600	600
Number of units	2	2	3	3
Tons capacity each unit	200	200	200	200

It is to be noted that two 200 ton capacity units are indicated for District C for the years 1955 and 1960. It is however, indicated that the landfill operation of refuse disposal provided some of the municipalities such as Upper Providence and Middletown Townships may better be handled by incineration. For this reason the incinerator plant capacity for District C has been taken as consisting of three 200 ton units.

It is to be further noted that the capacities of the incinerator units for the three plants has been taken as 200 tons per day. When bids are taken for the incinerator plant equipment the specifications should allow a range of between 150 and 200 tons per day, per unit. This will allow bidding by companies that have standardized on 150 ton capacity units as well as companies having 200 tons or greater capacity units.

8.4. LANDFILL REFUSE DISPOSAL

8.4.1. SECTIONS THAT MAY BE SERVED

Refuse disposal by landfill operations may be applicable to those parts of the county that are now sparsely settled, in particular, being those municipalities situated in the western parts of the county. Present population of these municipalities are comparatively small and present indications are that they are not now interested in having the Authority provide means for the disposal of their refuse.

8.4.2. LOCATIONS OF LANDFILL SITES

Should it be found desirable or should these municipalities wish to contract with the Authority to dispose of their refuse, the Authority could engage in landfill operations for the westerly and the northwesterly parts of the county in two areas designated as L1 and L2 and as shown in Figure No. 9.

8.4.3. DISTRICT L1

	1955	1960	1970	1980
Edgmont Township	1,280	2,100	3,500	5,000
1/3 Middletown Township	2,000	2,800	5,000	8,000
2/3 Newtown Township	4,000	6,000	12,000	14,000
1/3 Thornbury Township	800	900	1,400	2,000
Upper Providence Township	4,980	6,180	10,900	12,000
Total	13,060	17,980	32,800	41,000

8.4.4. DISTRICT L2

	1955	1960	1970	1980
Bethel Township	1,700	2,320	3,600	5,000
Birmingham Township	920	1,800	3,350	5,000
Chester Heights Borough	490	700	2,250	3,000
Concord Township	2,300	3,200	6,000	7,000
2/3 Thornbury Township	1,600	1,800	2,800	4,000
Total	7,010	9,820	18,000	24,000

8.4.5. AREAS REQUIRED

Based on an allowance of one acre per year per 10,000 population, the following areas would be required at the two sites:

Year	Populations	Acres per year	Total Area in Acres Increment	Total
Operation L1				
1955	13,060	1.3	--	--
1960	17,980	1.8	9	9
1970	32,800	3.3	33	42
1980	41,000	4.1	41	83
Operation L2				
1955	7,010	0.7	--	--
1960	9,820	1.0	4	4
1970	18,000	1.8	18	22
1980	24,000	2.4	24	46

8.4.6. USE OF METHOD

From the questionnaires sent to each municipality it is clearly indicated that the sparsely settled areas in the westerly and northwesterly parts of the county now have no interest in the disposal of their refuse by the Authority. For this reason and as landfill disposal only, is applicable to these areas, landfill operations by the Authority are not recommended at this time.

Landfill operations must, however, be used for the balance of the county until the refuse incinerator plants are constructed.

Sufficient land is available at each incinerator plant for this purpose, the areas being such that landfill operations can be conducted from some 2 to 3 years.

8.5. RECOMMENDATIONS

8.5.1. INCINERATOR PLANTS

It is recommended that three (3) incinerator plants be constructed by the Authority, situated at the sites previously described and as shown on Figure No. 9. It is further recommended that each plant should have a capacity of 600 tons per 24 hours, or 400 tons in an operating period of 16 hours, which allows two shift operations. The capacity of 600 tons per 24 hours for the plant to serve District C is somewhat greater than would be required, but it is felt that by making the plants all of one size, it will provide greater flexibility in the burning of the refuse inasmuch refuse could be diverted from one plant to another where one plant may tend to be overloaded.

8.5.2. LANDFILL OPERATIONS

The operation of landfills for refuse disposal are not recommended for the westerly and northwesterly parts of the county for the reasons previously given. Temporary landfill operations must, however, be conducted by the Authority at the sites of the three proposed incinerator plants, for the disposal of the refuse, until the plants are placed in operation. Charges for this should be at the same rate as for disposal by incineration.

8.5.3. PURCHASE OF LAND

Negotiations should be started for the purchase of land for the three incinerator plant sites. This should include the purchase of the existing incinerator plant and dump land in Haverford Township.

CHAPTER 9

ESTIMATED COSTS

9.1. CAPITAL COST REQUIREMENTS

9.1.1. COSTS INCLUDED

The estimated capital cost requirements are those needed for the construction of the three 600 ton capacity incinerator plants, the construction of an office for the Authority and its operating personnel, equipment for the temporary operation of landfills at the three sites, construction contingencies, engineering and legal costs and the bond discount.

9.1.2. CONSTRUCTION COSTS

Three Incinerator Plants as follows:

Equipment 3 plants	$3,300,000.	
Structures 3 plants	1,725,000.	
Grading, roadways, fencing, etc.	675,000.	
Settling ponds and water supply	125,000.	
Trucking and grading equipment	75,000.	
Plant construction cost		$5,900,000.
Allowance for landfill equipment		100,000.
Authority personnel building		50,000.
Land for two plants		30,000.
Purchase of Haverford plant and land		100,000.
Construction contingencies		400,000.
Engineering and legal costs		540,000.
Bond Discount		270,000.
Total estimated capital cost		$7,390,000.
Taken as		$7,400,000.

9.2. OPERATING COSTS

9.2.1. BASIS OF OPERATING COSTS

The incinerator plant operating costs are based on having 3 operators and 1 maintenance man per unit, plus a superintendent and an assistant superintendent at each plant, together with a weigh master at each plant. Power for plant operation has been taken as an average of 2 cents per kilowatt hour of electric current used. Labor and maintenance costs have been included for the operation of trucks and bulldozers for the hauling of clinker to the dumping area at each plant. The operating costs also include the Authority personnel to be provided at one of the plants for the Authority business and billing operations.

9.2.2. OPERATING COSTS

The following operating costs are based on the quantities of refuse for the year 1980 for Three Incinerator Plants and are as follows:

Operators	(2 shifts)	54 @	$5,000.	$270,000.
Maintenance men	"	9 @	6,000.	54,000.
Asst.Superintendent	(1 shift)	3 @	6,000.	18,000.
Superintendent	(1 shift)	3 @	8,000.	24,000.
Weigh master	(1 shift)	3 @	6,000.	18,000.

Total labor costs 72 men	$384,000.
Power - 3 plants	150,000.
Operation and maintenance of trucks & bulldozers	33,000.
Repairs and supplies	83,000.
Total operating cost	$650,000.
Authority operating personnel	25,000.
Total operating cost for year 1980	$675,000.

9.3. CAPITAL COSTS

9.3.1. BASIS OF COSTS

Capital costs consist of the sale of $7,400,000., in bonds, to finance the construction of the proposed work, the bond retirement period being assumed as being 25 years. They would be revenue bonds, the interest rate being probably not less than 4 percent.

The bond retirement cost given herein is the average cost over the 25 year life of the bonds and the interest cost is the average over the 25 year bond period.

9.3.2. BOND RETIREMENT AND INTEREST COSTS

Bond retirement	$296,000.
Bond interest	148,000.
Total of bond retirement and interest	$444,000.

9.4. TOTAL ANNUAL OPERATING COST AND FIXED CHARGES

9.4.1. TOTAL FOR 1980

The total operating charges and fixed costs, based on full plant operation for the year 1980 would be as follows:

Operating cost	$675,000.
Fixed charges	444,000.
Total annual cost	$1,119,000.

9.4.2. ESTIMATED COSTS PER TON 1955 to 1980

The estimated cost per ton of refuse incinerated in three plants would be about as follows:

	1955	1960	1970	1980
Total Costs				
Operating cost	$ 600,000	$ 625,000	$ 650,000	$ 675,000
Fixed charges	444,000	444,000	444,000	444,000
Totals	$2,044,000	$1,089,000	$1,094,000	$1,119,000
Avg. tons incinerated	187,800	207,900	236,700	249,000
Costs per Ton				
Operating cost	$3.20	$3.01	$2.75	$2.71
Fixed charges	2.36	2.14	1.88	1.78
Totals	$5.56	$5.15	$4.63	$4.49

Probable Average per ton $5.00

9.3.4 ANNUAL COST TO EACH MUNICIPALITY

Based on the population and the annual amounts of refuse to be collected from each as given in Chapters Nos. 3 and 4, Population Studies and Quantities of Refuse, respectively, and the population included under each district as outlined in Chapter No. 8, Recommended Methods of Disposal, the annual cost to each municipality would be as given in the following tabulation. These costs are based on the cost per ton for each year between 1955 and 1980 inclusive.

Town	1955	1960	1970	1980
Aldan Borough	$ 9,200	$ 9,100	$ 8,900	$ 8,800
Aston Township	15,000	17,200	20,400	25,100
Brookhaven Borough	6,700	8,500	11,100	14,400
City of Chester	156,300	151,400	141,700	140,100
Chester Township	9,100	12,900	21,000	21,600
Clifton Heights Borough	17,900	17,300	16,500	16,200
Collingdale Borough	22,200	22,000	20,200	19,800
Colwyn Borough	4,900	4,700	4,600	4,900
Darby Borough	31,400	30,100	27,400	26,900
Darby Township	22,200	24,500	25,200	25,100
East Lansdowne Borough	8,000	7,600	7,000	6,800
Eddystone Borough	7,200	7,000	6,700	6,800
Folcroft Borough	9,900	11,700	13,500	14,400
Glenolden Borough	16,500	16,500	15,500	15,100
Haverford Township	110,000	113,300	118,500	122,100
Lansdowne Borough	28,800	28,000	25,900	25,300
Lower Chichester Township	7,500	8,100	9,600	12,600
Marcus Hook Borough	8,600	8,000	7,300	7,200
Marple Township	24,900	32,100	40,700	49,400
Media Borough	13,900	14,000	13,000	12,900
Middletown Township	11,400	11,700	21,900	21,500
Millbourne Borough	2,000	1,900	1,700	1,700
Morton Borough	4,000	3,900	3,600	3,600
Nether Providence Township	18,300	25,800	28,300	28,700
Newtown Township	3,800	9,900	12,200	10,800
Norwood Borough	12,600	12,000	11,000	10,800
Parkside Borough	4,600	4,600	4,300	4,200
Prospect Park Borough	14,400	14,400	13,900	13,700
Radnor Township	40,900	45,300	52,200	53,900
Ridley Township	59,600	61,800	58,200	57,500
Ridley Park Borough	14,600	15,200	14,400	14,000
Rose Valley Borough	1,200	1,300	1,800	2,100
Rutledge Borough	2,100	2,000	1,800	1,800
Sharon Hill Borough	14,500	14,400	13,900	13,800
Springfield Township	48,200	52,300	53,300	53,900
Swarthmore Borough	13,000	12,600	11,600	11,300
Tinicum Township	12,900	12,200	11,800	11,500
Trainer Borough	4,600	4,500	4,800	5,100
Upland Borough	10,800	10,700	11,100	11,500
Upper Chichester Township	17,200	18,600	33,300	37,700
Upper Darby Township	203,000	194,300	181,500	179,600
Yeadon Borough	25,500	23,600	22,400	21,900
Total Charges	$ 1,069,400	$1,097,000	$1,123,700	$1,146,100

CHAPTER 10

PROPOSED COLLECTION METHODS

10.1 PRESENT METHODS

10.1.1 GENERAL PRACTICE

Under the best conditions the collection of refuse is not a pleasant job. It is dirty, dusty and more often than not it is odorous. The men engaged on the work generally operate under adverse conditions as not only is the work heavy, but generally the individual refuse loads must be lifted to considerable heights to the receiving trucks.

The methods and equipment used vary greatly in the various municipalities. These are described in detail in Chapter 2, Present Refuse Collection and Disposal Practices.

10.1.2. UNIFORM PRACTICE

When the proposed facilities of the Authority are in operation each municipality should be required to adopt as uniform a method of collection as is economically feasible. The collecting trucks should be arranged to haul mixed refuse to the incinerator plants or to the sanitary fill areas. Garbage should be wrapped in paper and deposited in suitable containers, having tight fitting covers, with other refuse. Large refuse, such as discarded furniture, cartons, tree limbs, etc. should be limited in size and weight to the handling ability of the collecting crew.

Packer trucks are preferable to other types of vehicles, and the municipalities collecting their refuse, should eventually adopt these for refuse collection. Where refuse collection is by private contract, either municipal or is paid by the household, the contractor should again be required to use packer loaders, even though this may require a long term collecting contract.

Uniform codes should be adopted by each municipality setting forth the requirements for the refuse containers; points of collection, house, curb or alley; the days on which collections will be made and other factors entering into the preparation and collection of the refuse.

10.1.3. COLLECTION VEHICLES

All conditions pertaining to the collection of the refuse must be handled by the various municipalities utilizing the disposal facilities of the Authority. The Authority, under its scale of operations, will have no direct control over the manner in which the refuse is collected, but it can insist on the use of closed body type of motor vehicles, which as previously stated, should preferably be of packer type. This should be required to prevent littering of streets between the points of collection and the disposal areas as there will be a large concentration of trucks at the points of disposal. Complaints of littering, dust, etc. at disposal points would probably be directed against the Authority.

10.1.4 COMPACTOR TRUCKS

Fundamentally, the collecting trucks should have ample capacity. They should be watertight to prevent nuisance created by liquids dropping on the streets. They should be covered to avoid blowing papers and other particles of rubbish from causing nuisances. The trucks will not only have to pass through the community where the refuse is collected, but through other communities to reach the points of disposal, so therefore, they should be neat and sanitary in appearance.

To increase truck loads, bodies can be equipped with compactor mechanism of some type. These keep packing the refuse until there is a compact, solid mass. Baltimore replaced 12 yard, open-body trucks with 9 yard Gar Wood Compressor type closed bodies. It was estimated that the closed bodies would reduce the operating costs enough to pay for themselves in 3 years. In Newark, N.J., compressor type bodies load the refuse to a density of 280 to 400 pounds per cubic yard. In open trucks the density was 180 to 300 pounds. Hackensack, N. J., found that compressor type trucks made four trips to collect 7.5 tons of refuse in 6 hours of operation, previous to which, open type trucks required nine trips in 8 hours. Worcester, Mass., reduced its refuse crew by one man and loaded 50 percent more refuse on a truck. These increased loadings per truck and reduced operating costs should be carefully considered by each municipality planning its refuse collection system.

10.1.5. MEASURING AMOUNTS OF REFUSE DISPOSED OF

There should be a weighing station at each point of disposal to weigh the incoming and out going trucks to secure the net weights of the refuse delivered to the points of disposal.

10.1.6. BILLING PRACTICE

Weight records of the amounts of refuse disposed of must be kept for monthly, or other periods of billing, that may be required, and sent to the municipalities where refuse collection is a municipal function.

Likewise they would be sent to the municipalities which contract the collection service to private contractors. In these cases they would form the basis of billing these municipalities for the amounts disposed of by the Authority and in addition they would serve as records for the payments by the municipalities to the collecting contractors.

The payment for refuse disposal services in municipalities where the collecting service is paid directly by the householder, would have to be handled similarly to that for municipalities having private contracts for the refuse collection services. In these cases, the billing for refuse disposal would also be directly to the municipalities. At the present time many mercantile establishments and industrial plants have their waste collected and disposed of by private contractors. Where municipal service is provided, or where private contractors are employed by the municipality, the mercantile establishments and the industrial plants should pay the municipality in which they are located for this service. Billing for disposal services would then be the same as described for municipalities having contracts with private collection.

CHAPTER 11

OPERATION OF AUTHORITY

11.1 ENABLING ACT

The authorization leading to the creation of The Delaware County Incinerator Authority was enacted by the State of Pennsylvania under Act No. 164, May 2, 1945, (P.L. 382), and known as "Municipal Authorities Act of 1945".

Section 4. - Purposes and Powers; General

A. Every Authority incorporated under this act shall be a body corporate and politic, and shall be for the purpose of acquiring, holding, constructing, improving, maintaining and operating, owning, leasing, either in the capacity of lessor or lessee, projects of the following kind and character, buildings to be devoted wholly or partially for public school buildings, and for revenue-producing purposes; transportation, marketing, shopping, terminals, bridges, tunnels, flood control projects, highways, parkways, traffic distribution centers, parking spaces, airports and all facilities necessary or incident thereto, parks, recreation grounds and facilities, sewers, sewer systems or parts thereor, sewage treatment works, including works for treating and disposing of industrial waste, steam heating plants and distribution systems, incinerator plants, waterworks, water supply works, water distribution systems, swimming pools, playgrounds, lakes, low head dams, hospitals, motor buses for public use, when such motor buses are to be used within any municipality, and subways.

11.2 INCORPORATION AND AUTHORITY MEMBERS

The Delaware County Incinerator Authority was incorporated under the foregoing Enabling Act on April 22, 1954, for the purpose of ascertaining proper means for the disposal of refuse originating in all parts of Delaware County and to provide proper and sanitary means for the disposal of refuse from such parts of the County as can be economically included in a comprehensive program of refuse disposal.

The present members of the Authority are as follows:

Norman K. Seiple, Chairman
John A. Carr, Secretary
Norman G. Young, Member
Perry Martin, Member
Clarence T. Pepper, Member
James A. Cochrane, Solicitor

Meetings are held in the Media County Courthouse the third Thursday of each month.

11.3 OPERATION OF AUTHORITY

As previously stated the Authority was originated to devise and finance, by the sale of revenue bonds, means for the disposal of the refuse originating in Delaware County in a satisfactory and sanitary manner. To assist in the determination of this the Authority authorized the making of a refuse survey of the county to ascertain the present and future populations of the various political sub-divisions of the county, the amounts of refuse to be disposed of and a determination of the proper means of refuse disposal. This is given in this report.

Based on the findings in this report the Authority must now determine the extent to which it will engage in the recommended method of disposal. After this has been done it must authorize the preparation of contract drawings, specifications and contract documents covering the construction of the refuse disposal facilities. It must also engage bond attorneys to set up the bond issue to finance the proposed work and arrange for the sale of the bonds.

11.4 AGREEMENTS WITH MUNICIPALITIES

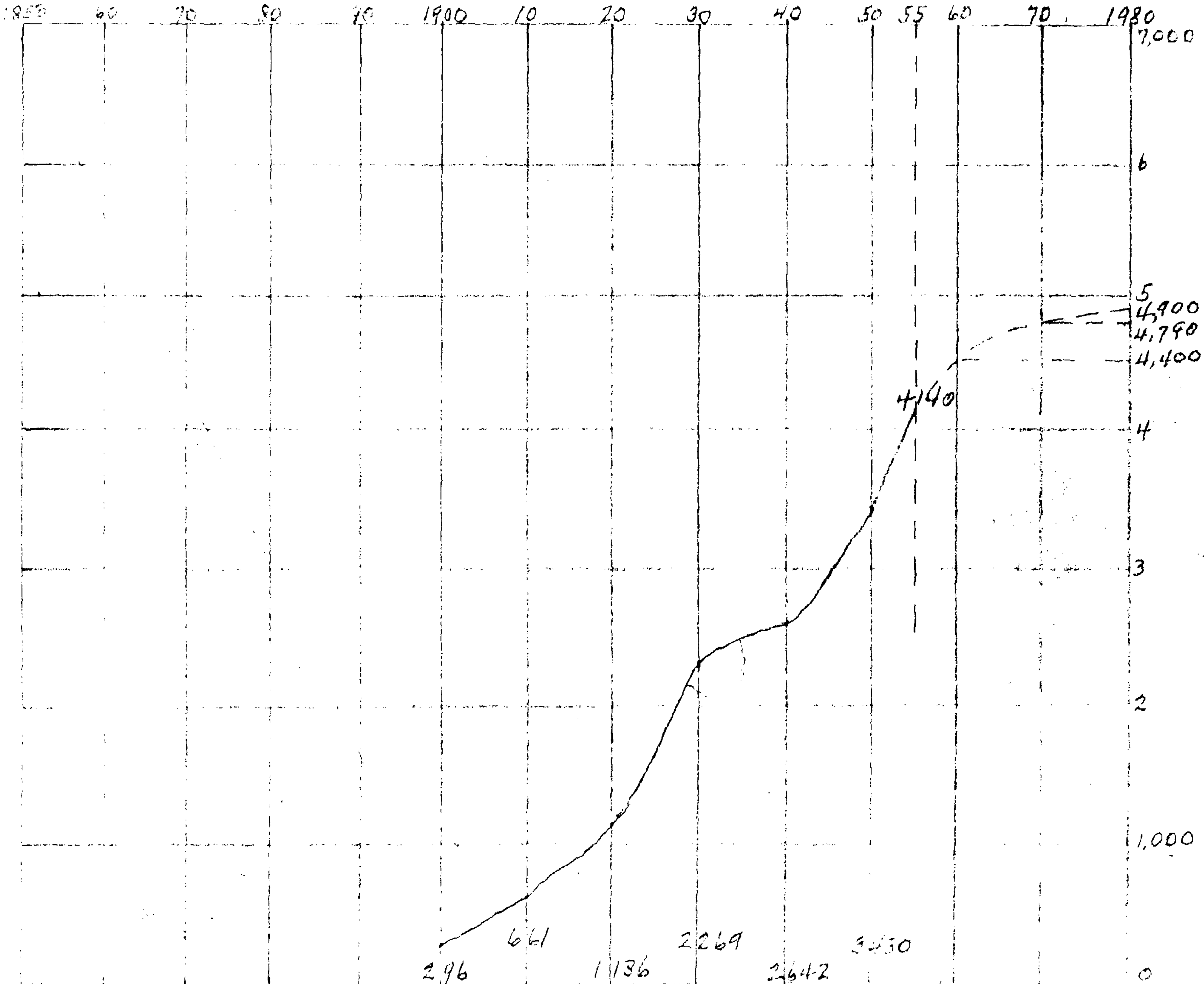
It is essential that agreements be made between the Authority and the various municipalities using its disposal facilities. It must be realized that the amounts collected vary widely and some means must be provided whereby the payments made to the Authority by the municipalities will cover the fixed capital and the operating costs of the disposal facilities.

As the marketability of the bonds will be largely influenced by the revenues accruing the Authority, the disposal agreements should be in the form of a minimum or ready to use charge, which would be paid to the Authority irrespective of the amounts of refuse disposed of, and above this there should be a charge based on the amounts of refuse actually disposed of. This is an important feature as funds must always be available to the Authority for the retirement of the bonds, interest costs on the bonds, and the operating and maintenance costs.

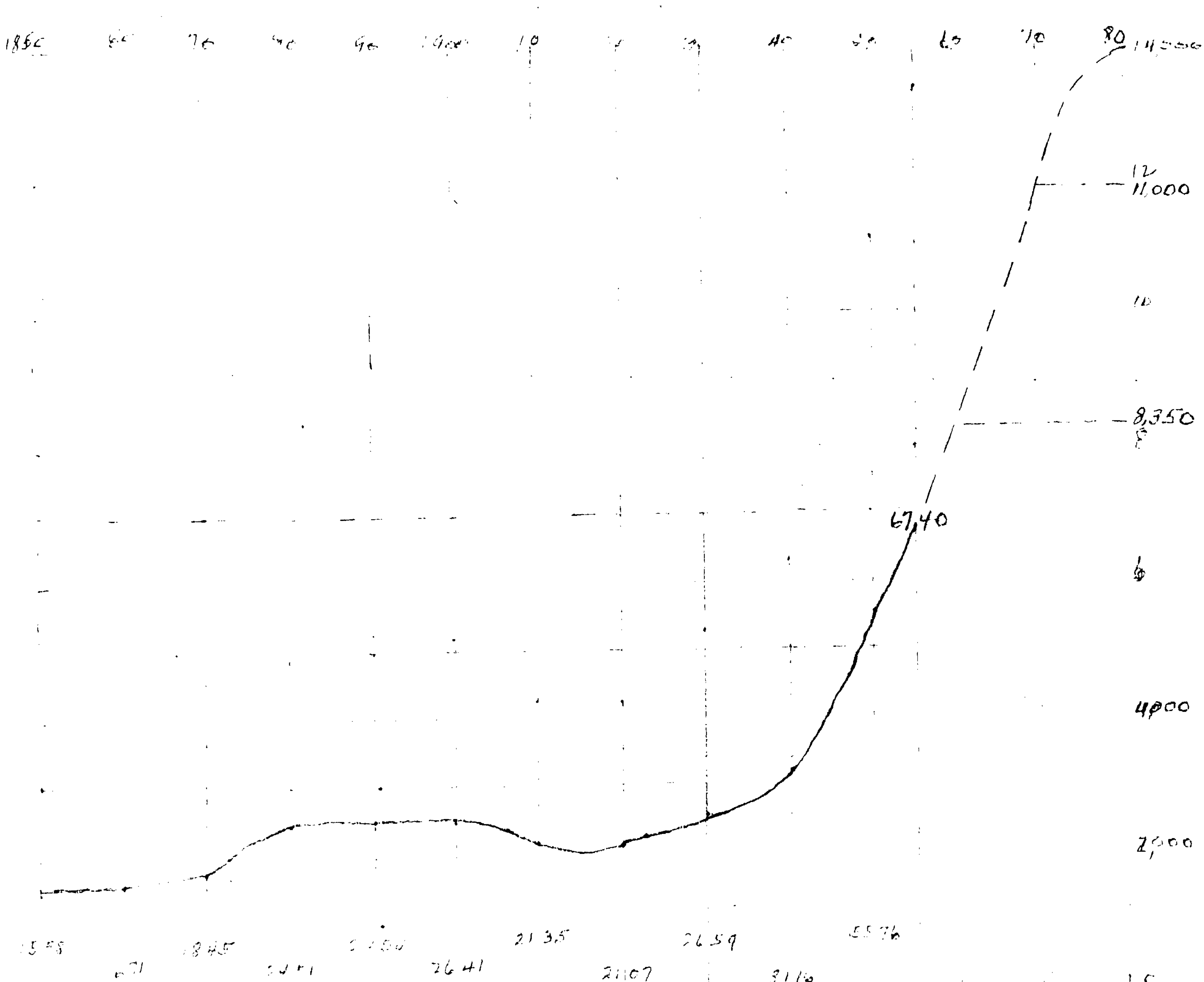
11.5 BILLING PROCEDURE

The Authority must set up an organization to handle the business of the Authority and the billing of the various municipalities for refuse disposal facilities. These would be based on the weigh tickets issued by the weighmaster at each incinerator plant. The personnel of the organization would be housed in a building forming a part of one of the incinerator plants.

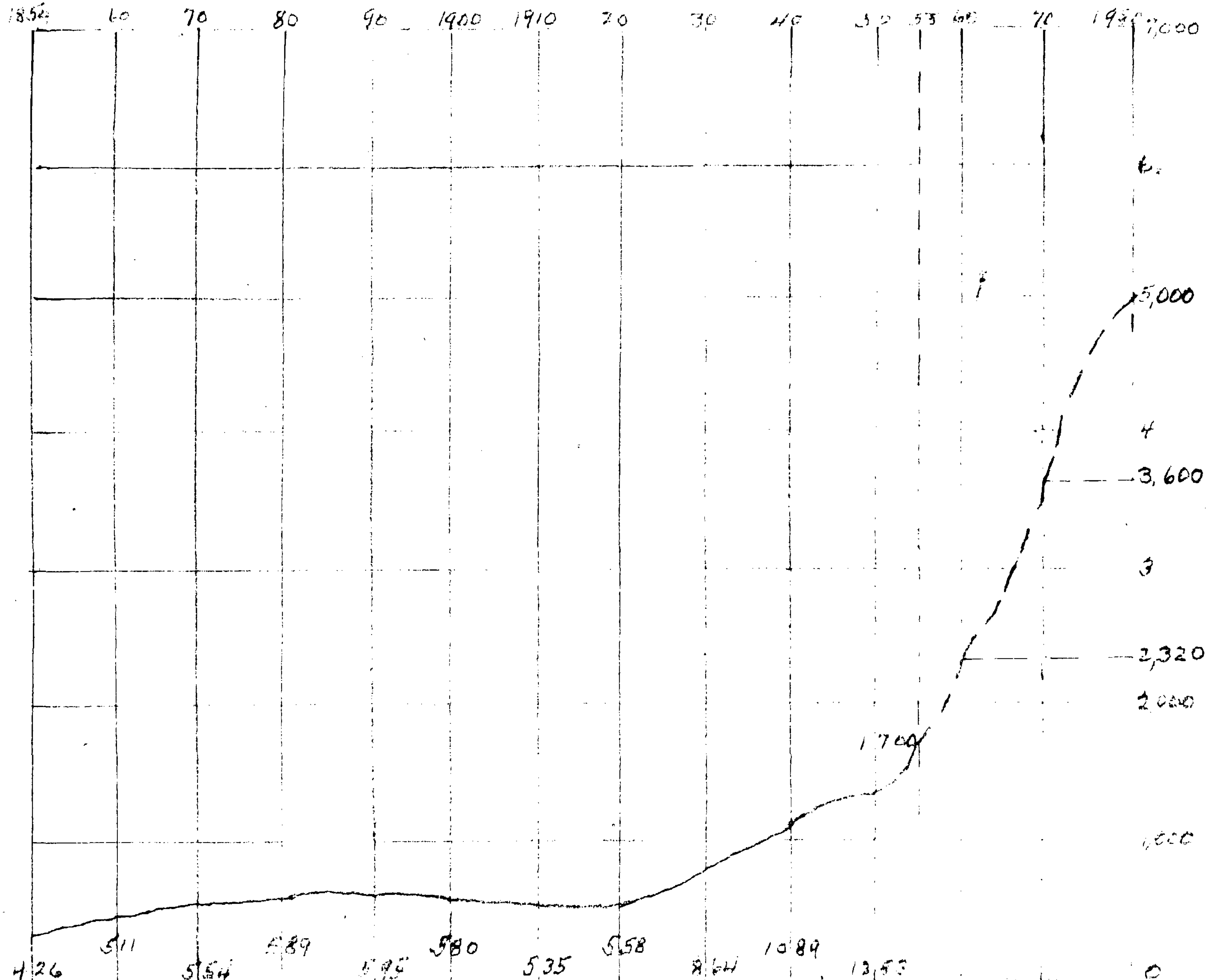
Details of the billing procedure would be determined when the details of the agreement with the various municipalities are completed and a determination made of the manner in which the refuse disposal services are to be paid for,



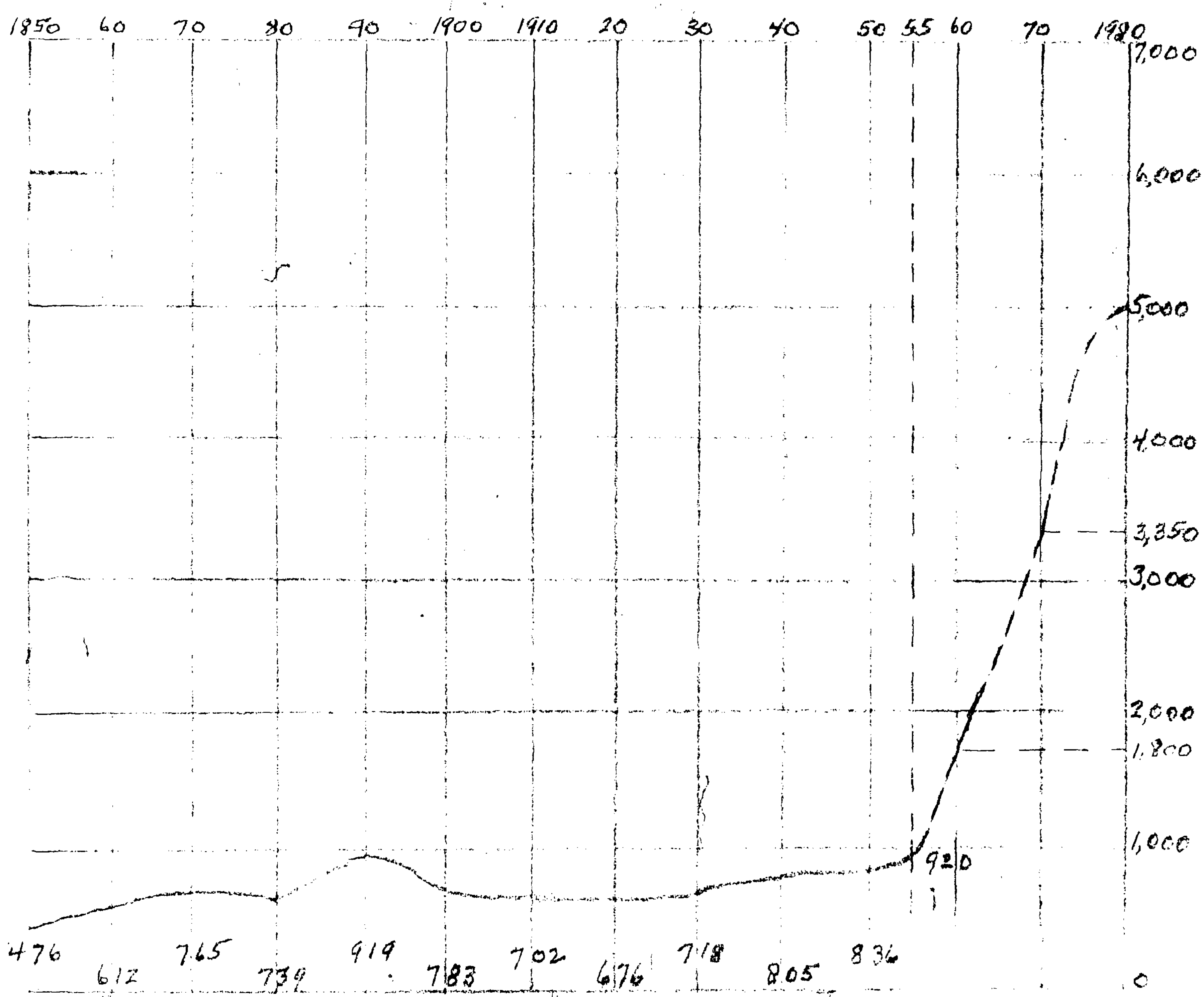
Aldan Boro. — Density-1955 EST- 7,400/sq mi. - 11.5/A



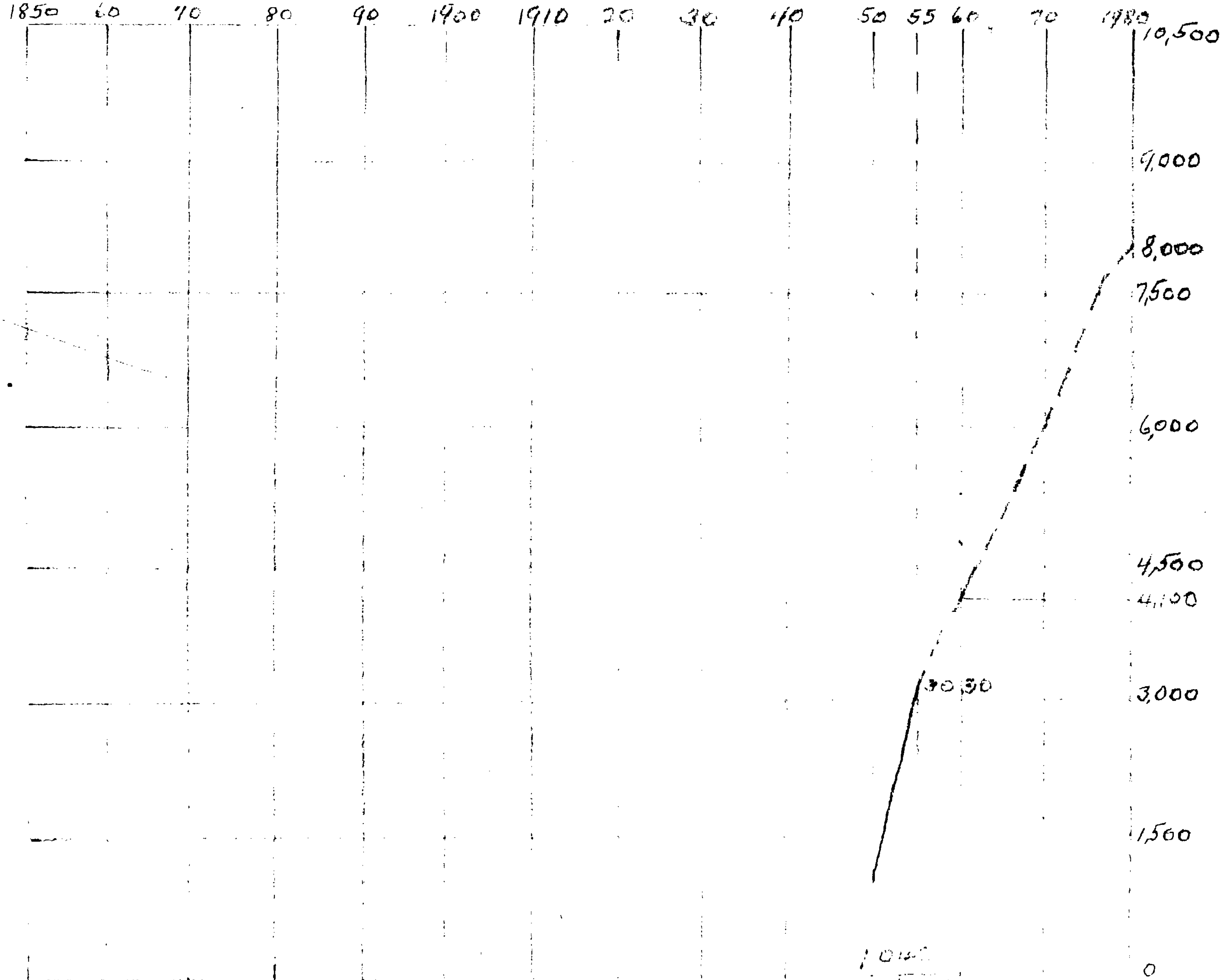
Aston Twp. — Density 1985 EST 1325 □ mi. → 1.91 A



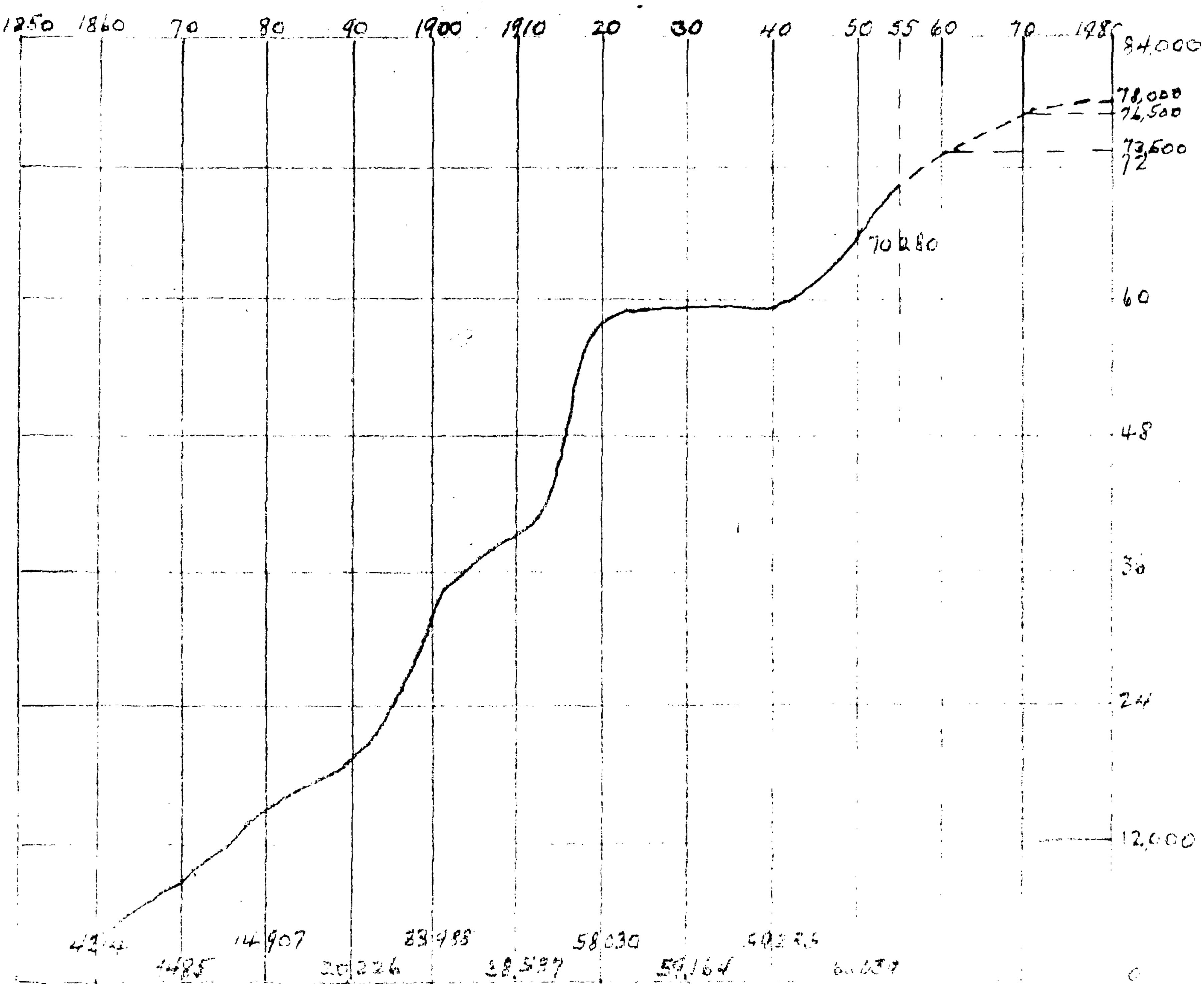
Bethel Twp, — Density 1950 ... 312/sq mi ... 51/R



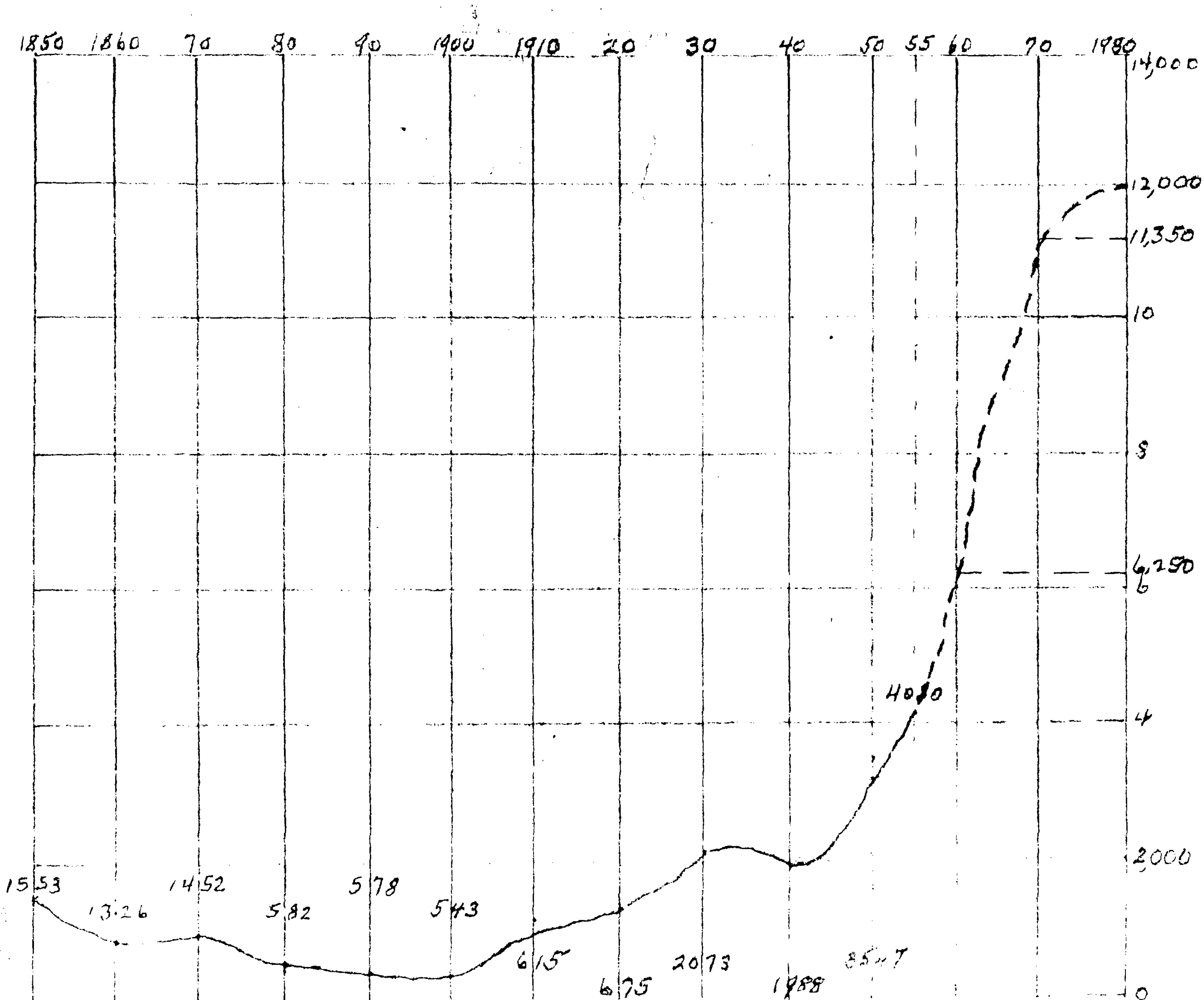
1850 60 70 80 90 1900 1910 20 30 40 50 55 60 70 1980
7,000
6,000
5,000
4,000
3,350
3,000
2,000
1,800
1,000
0
920
476
612
765
739
919
783
702
676
718
805
836



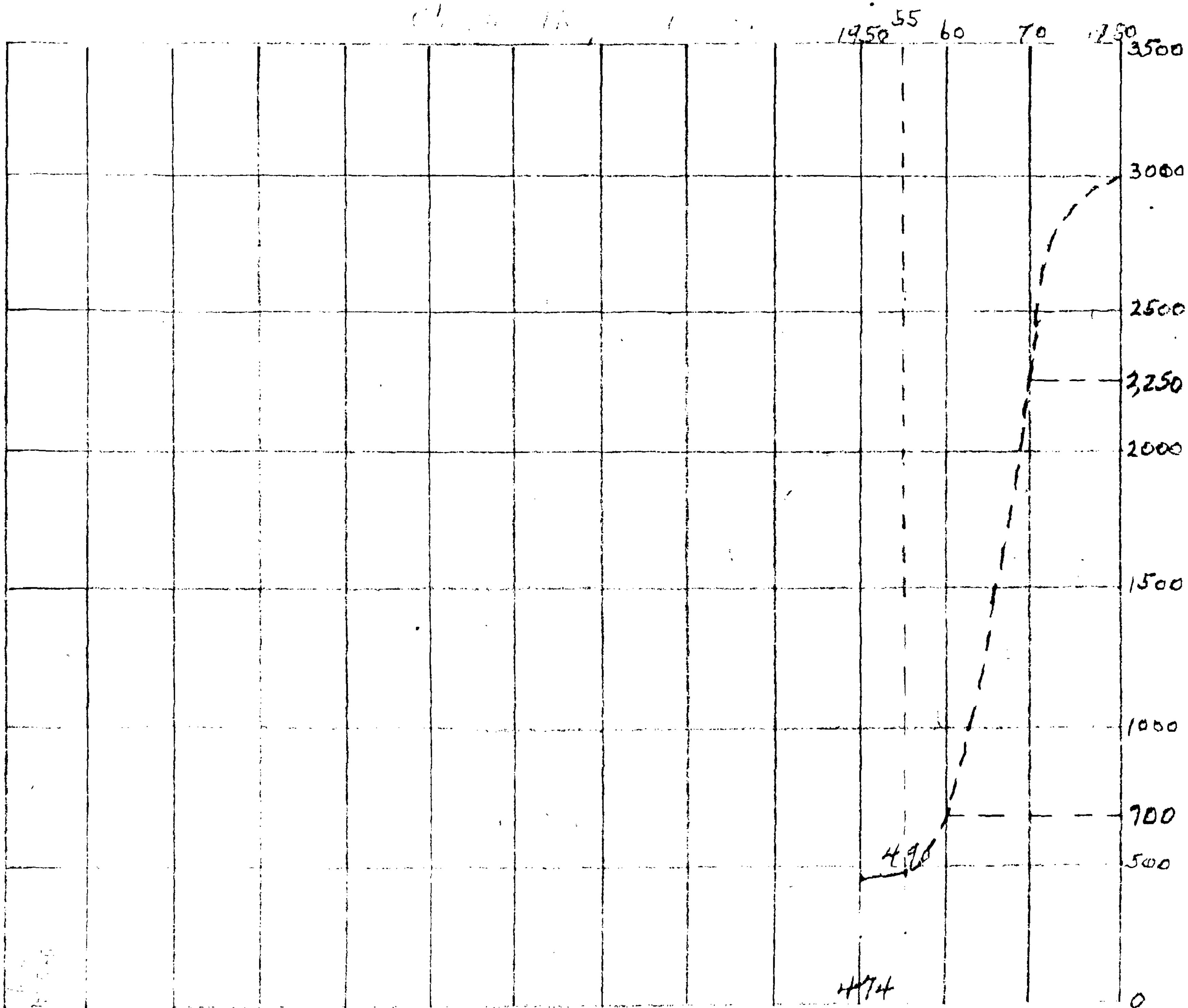
Boro. — Density - 1955 Est. - 1,790/□mi. - 2.78/H



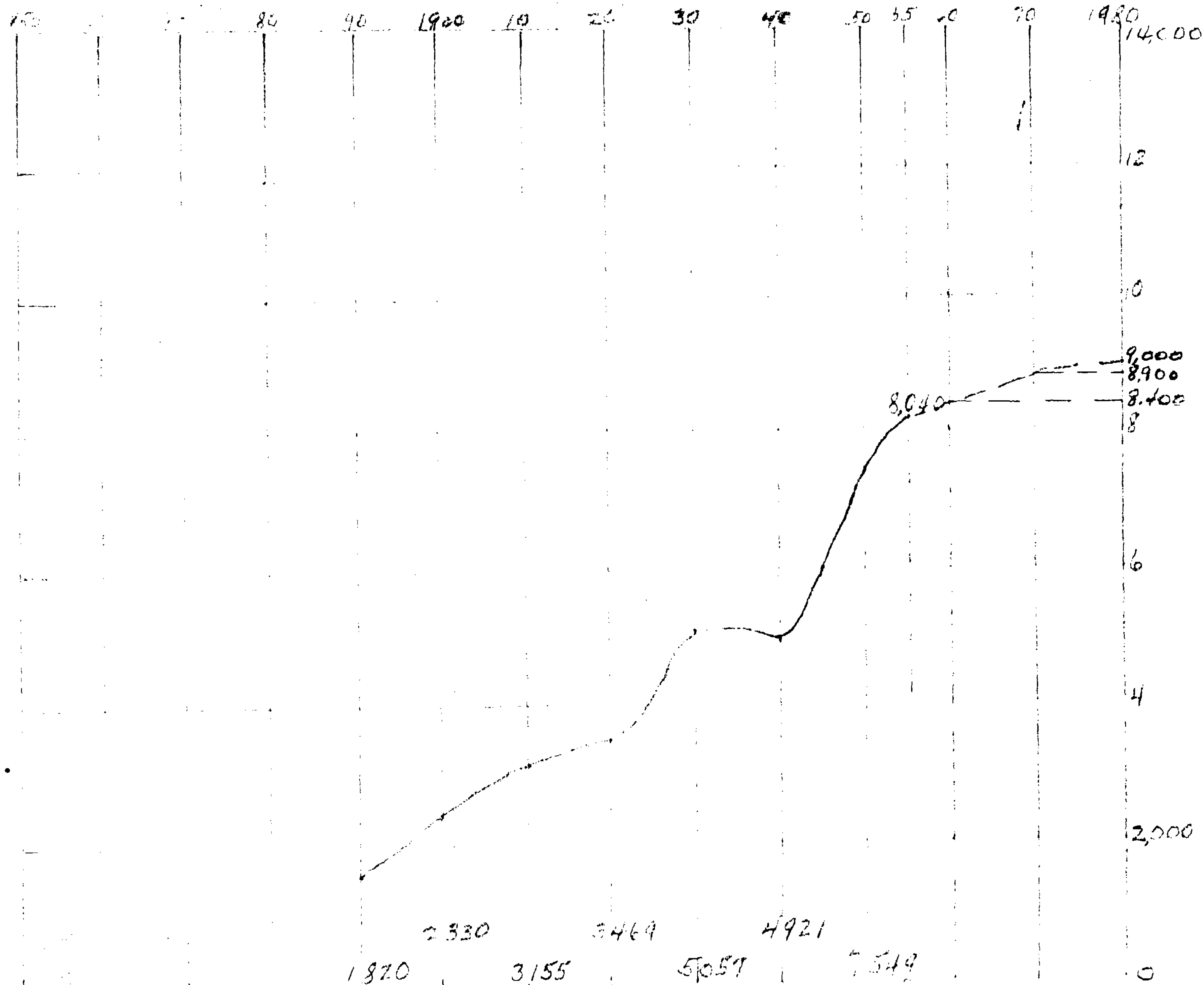
City of Chester — Density - Est. 1955 15,690 □ mi. - 24.6A



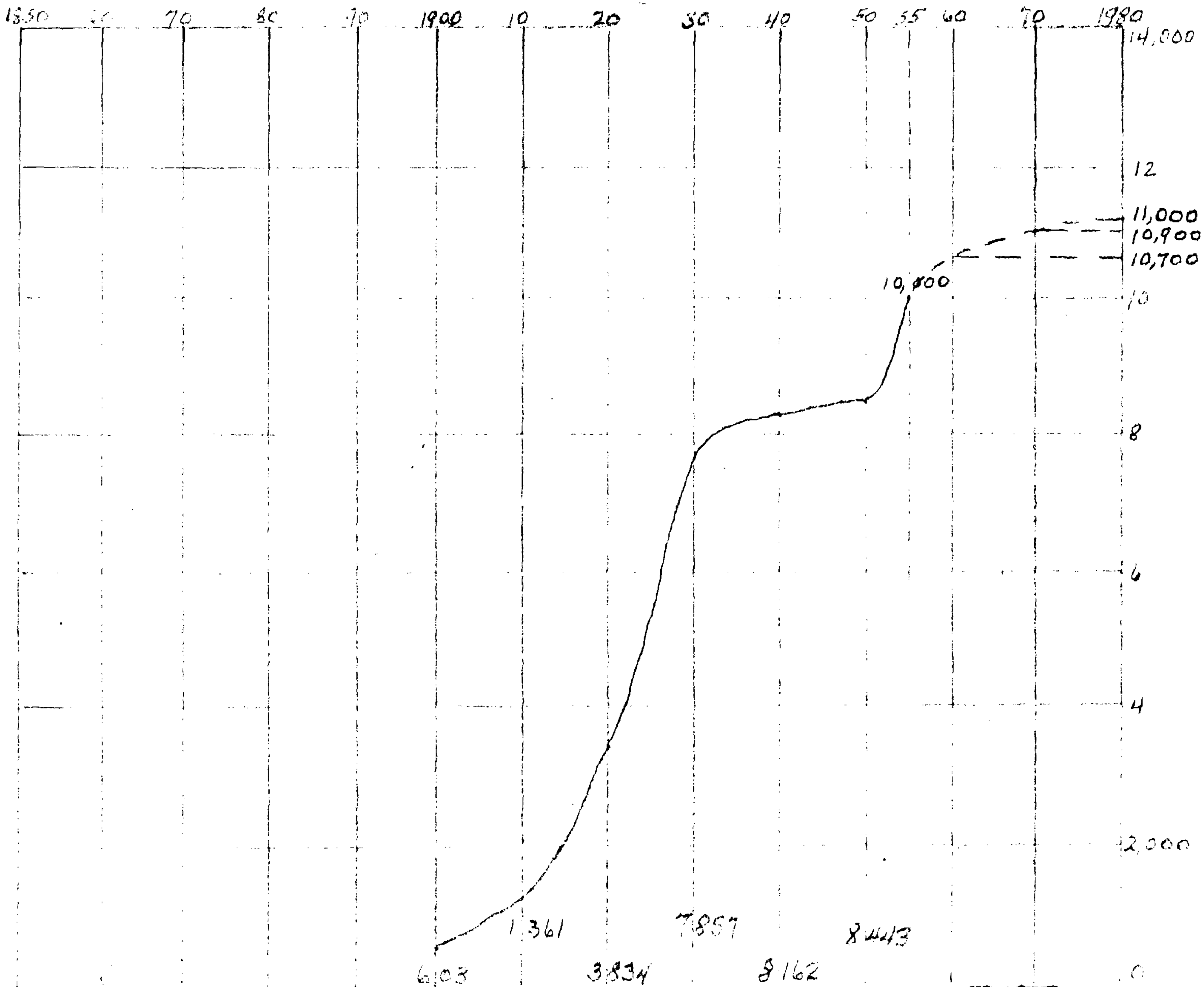
Chester Twp.-Density-1955 Est.-1,851/□ mi.-2.9/A.



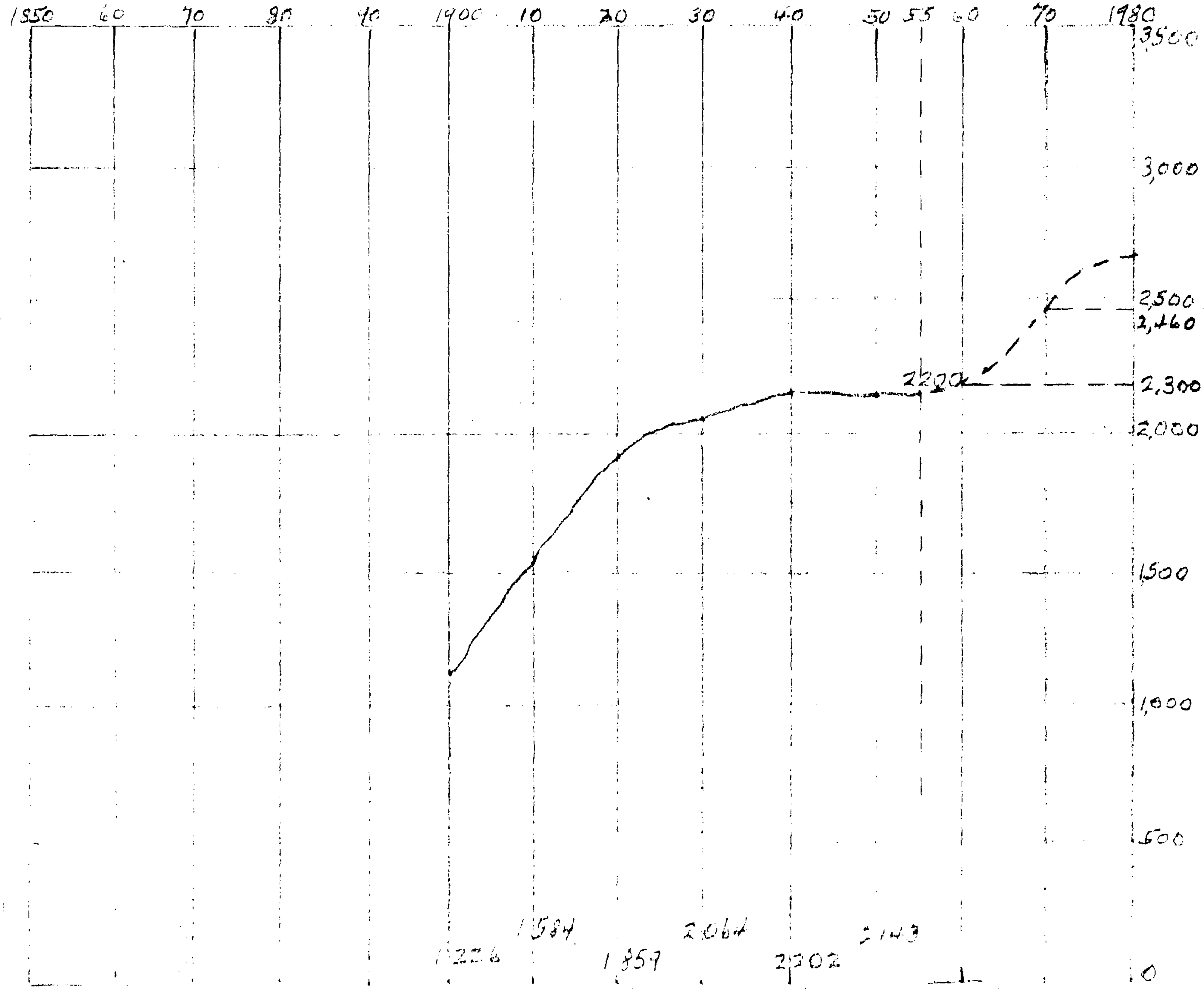
Chester Heights Boro.—Density—1955 Est. 213/mi.—.33/A



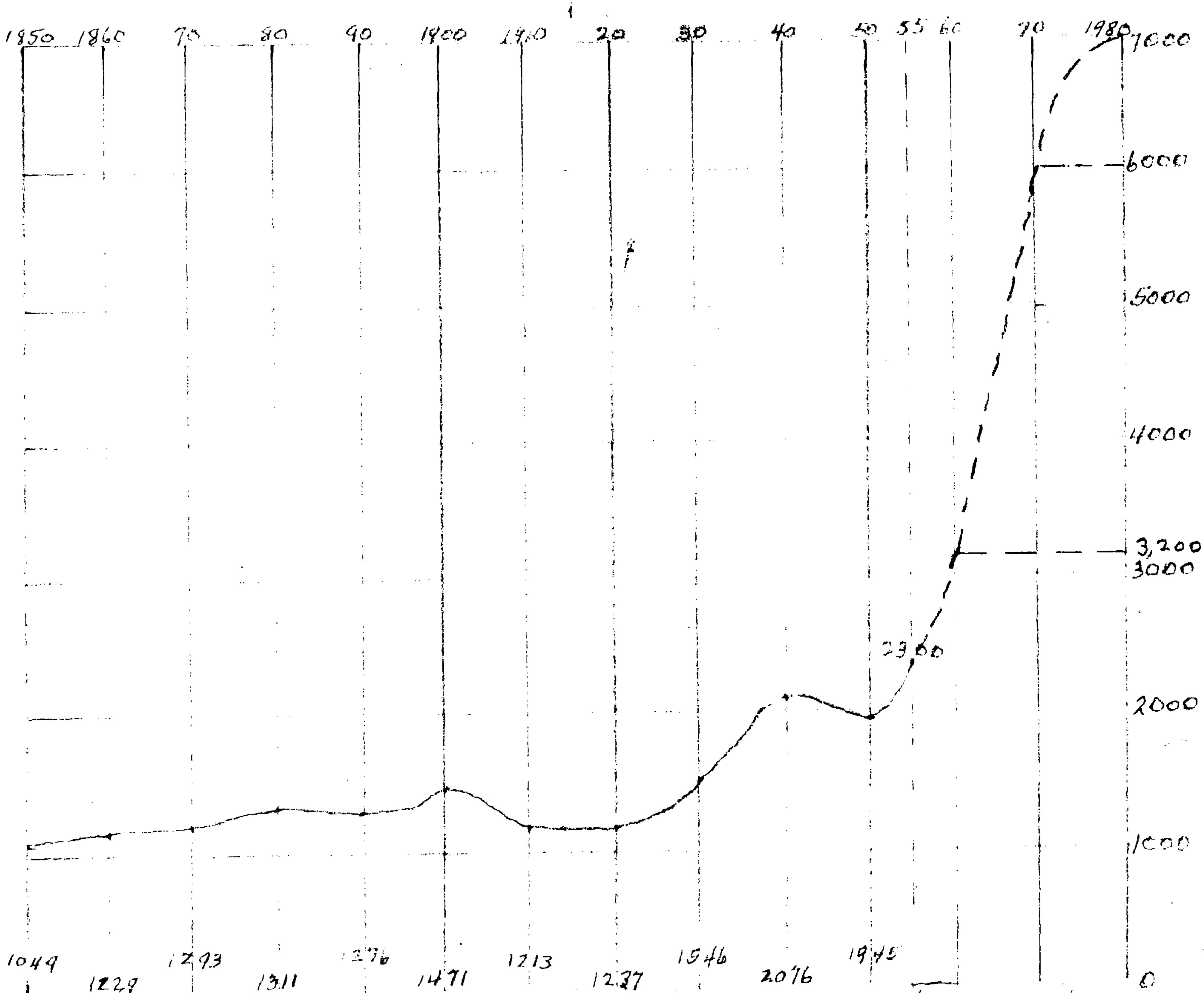
Clifton Heights Boro. — Density - 1955 Est. - 10,441/□mi. - 16.30'A



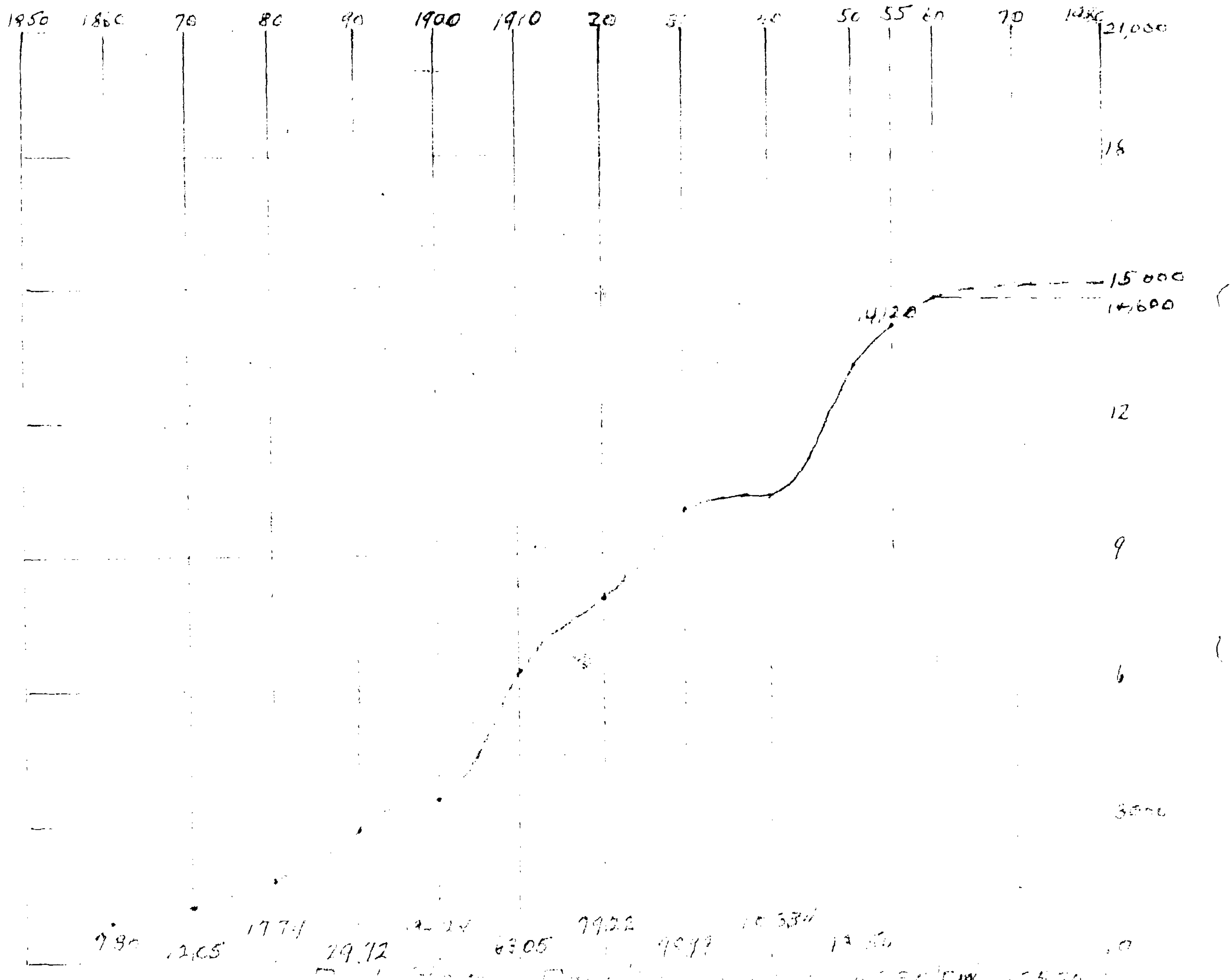
Collingdale Boro — Density 1955 Est — 10,746/□mi. — 680 A



Colwyn Boro.—Density—1955 Est.—8,800/□mi.—13.50 A



Concord Twp — Density - 1955 Est. 16 ☐ mi. · .26/A


1850
1860
70
80
90
1900
1910
20
50
55
60
70
21,000
18
15 000
14,600
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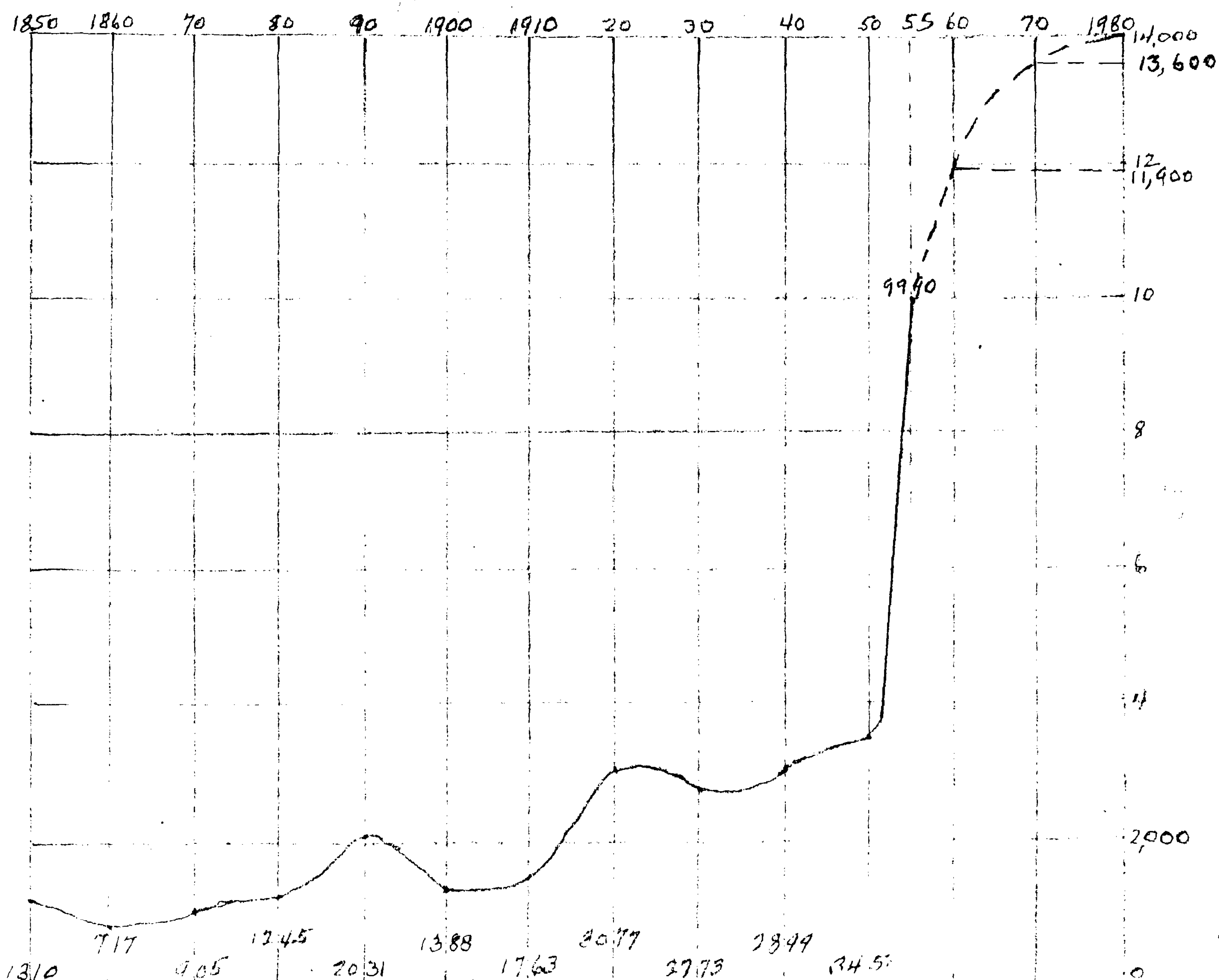
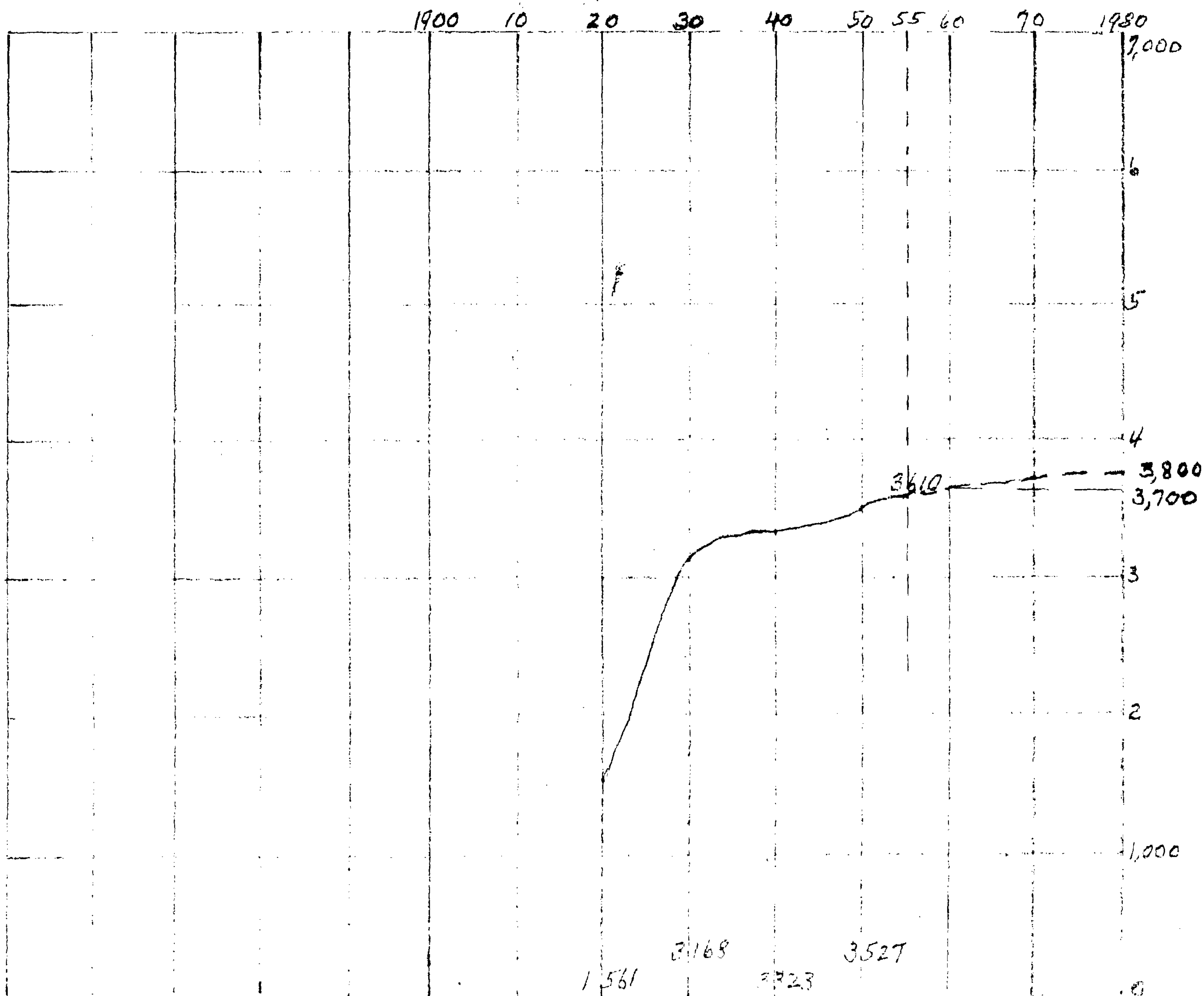
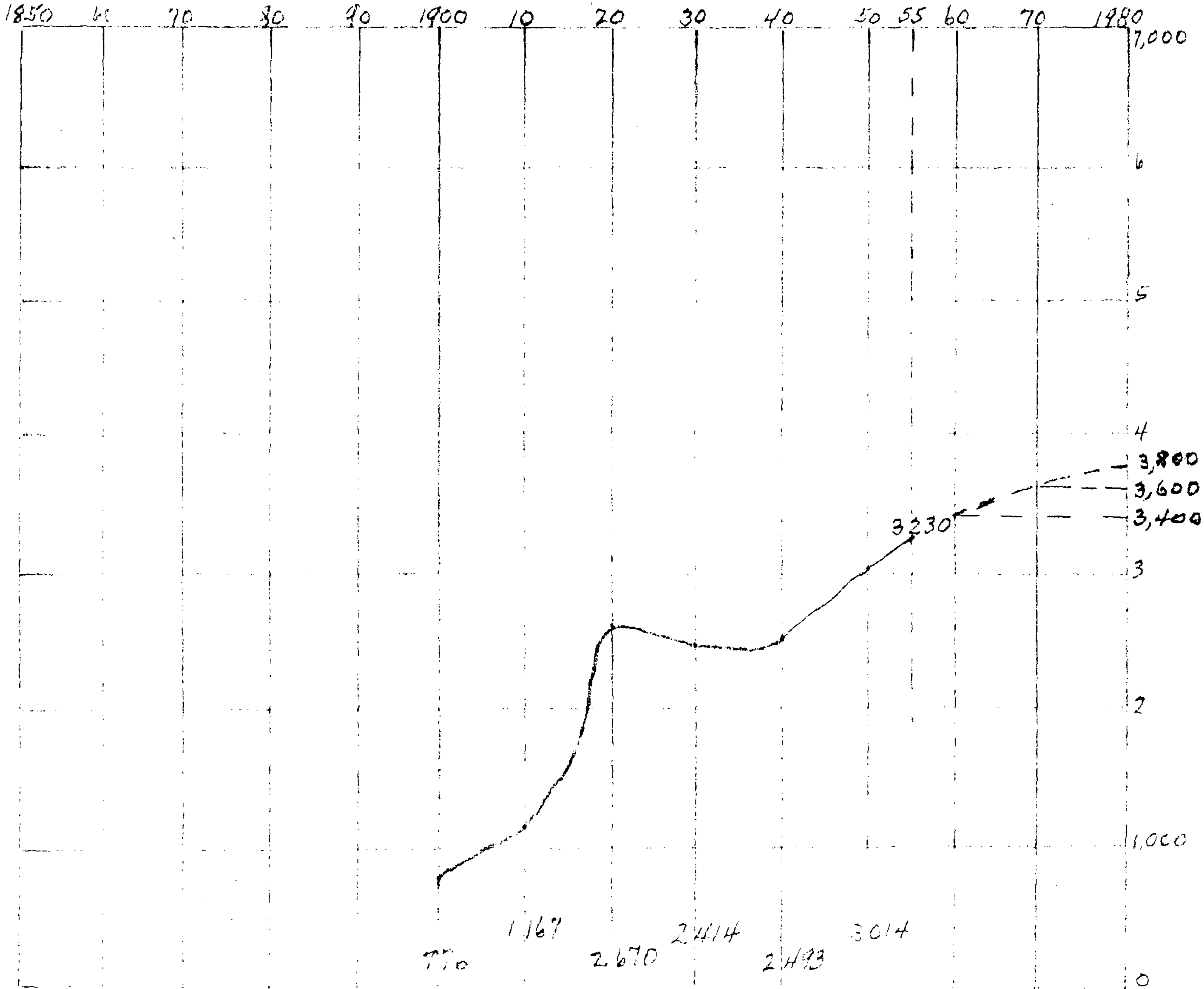
6
3000
29.72
6305



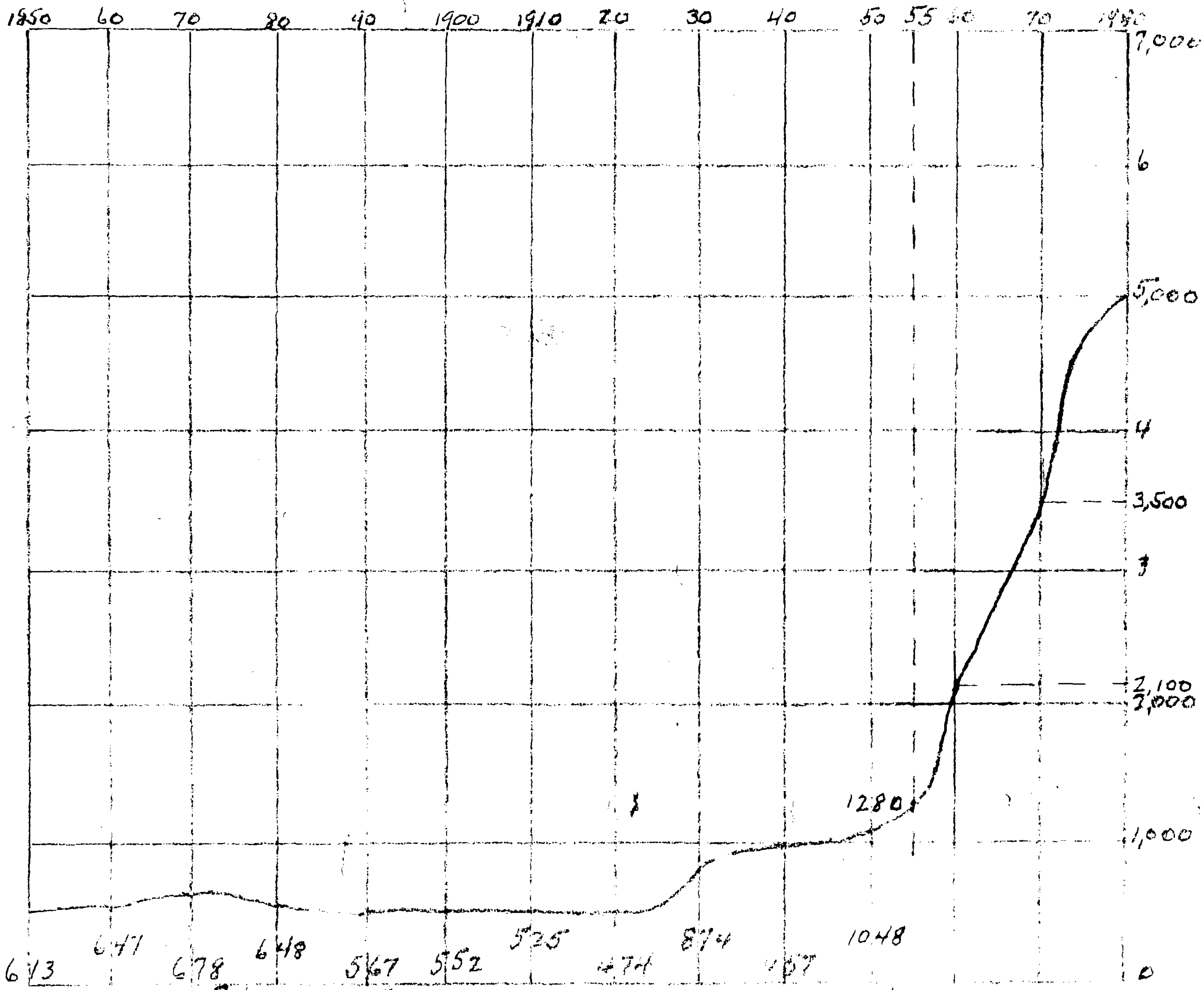
Darby Twp. — Density- 1955 Est- 4,160/sm — 6.50/A



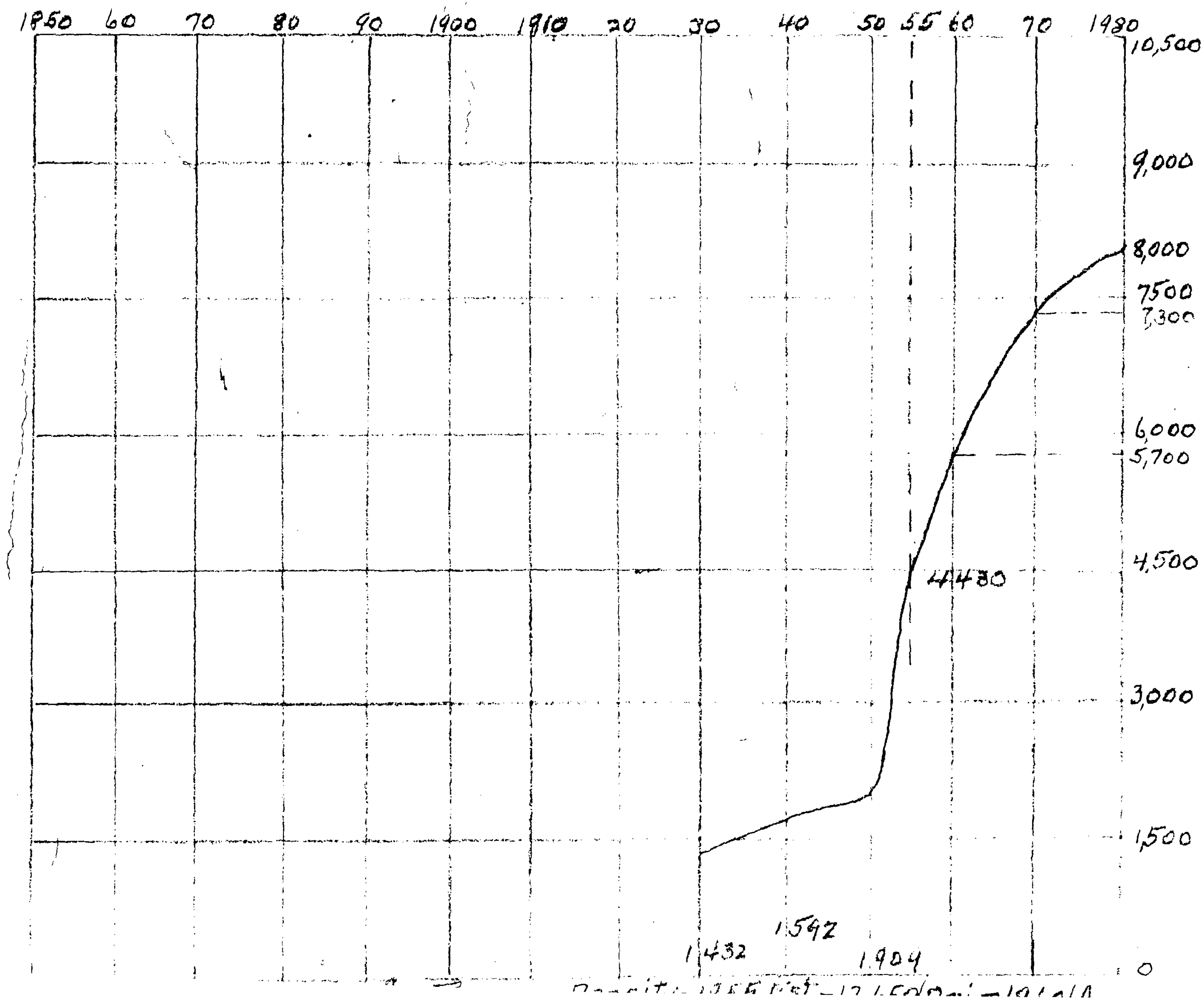
1900
10
20
30
40
50
55
60
70
1980
7,000
6
5
4
3
2
1,000
0
3,800
3,700
3610
1561
3168
3323
3527

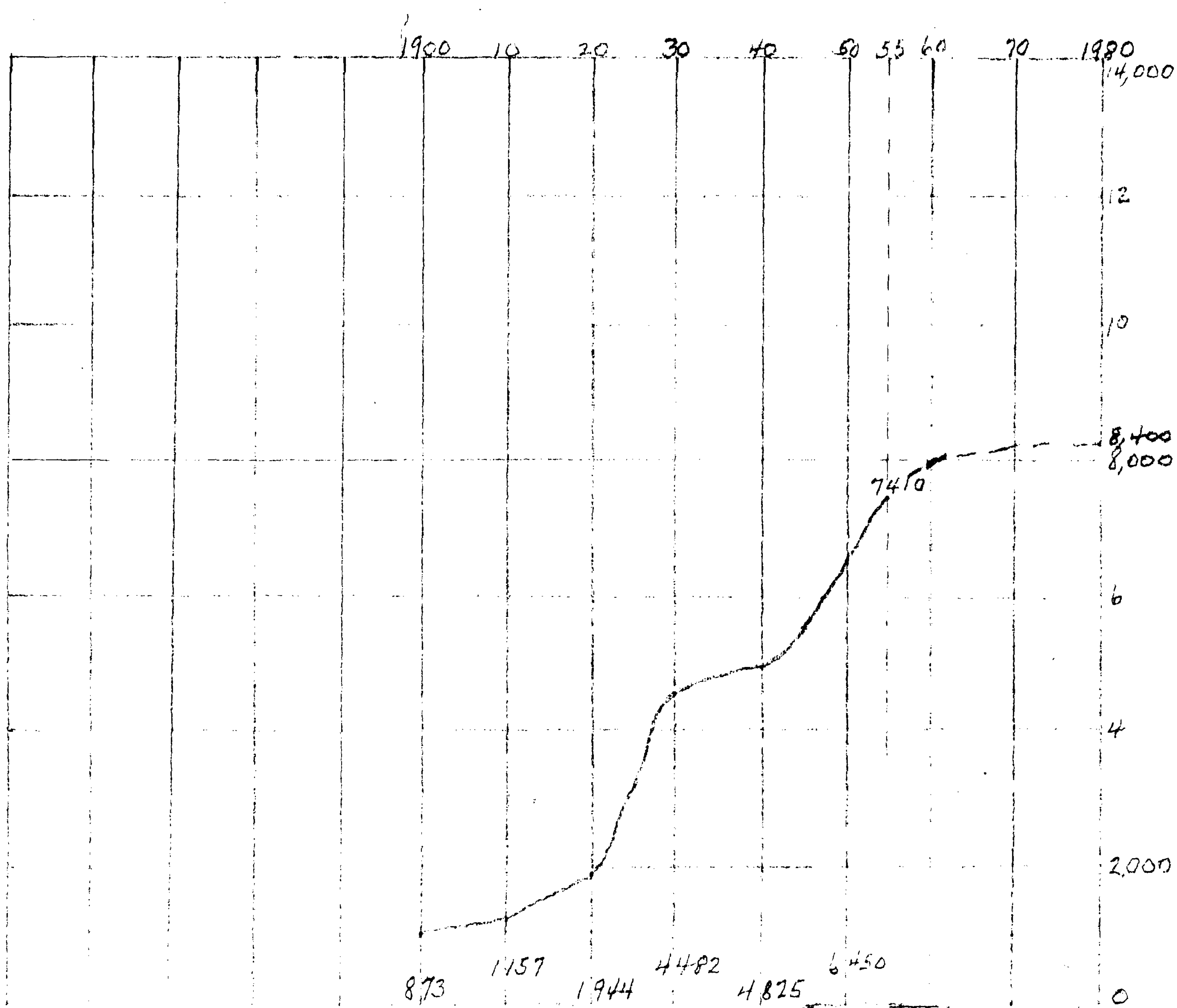


[illegible] — Density — 1955 Est — 3,755/mi. — [illegible]

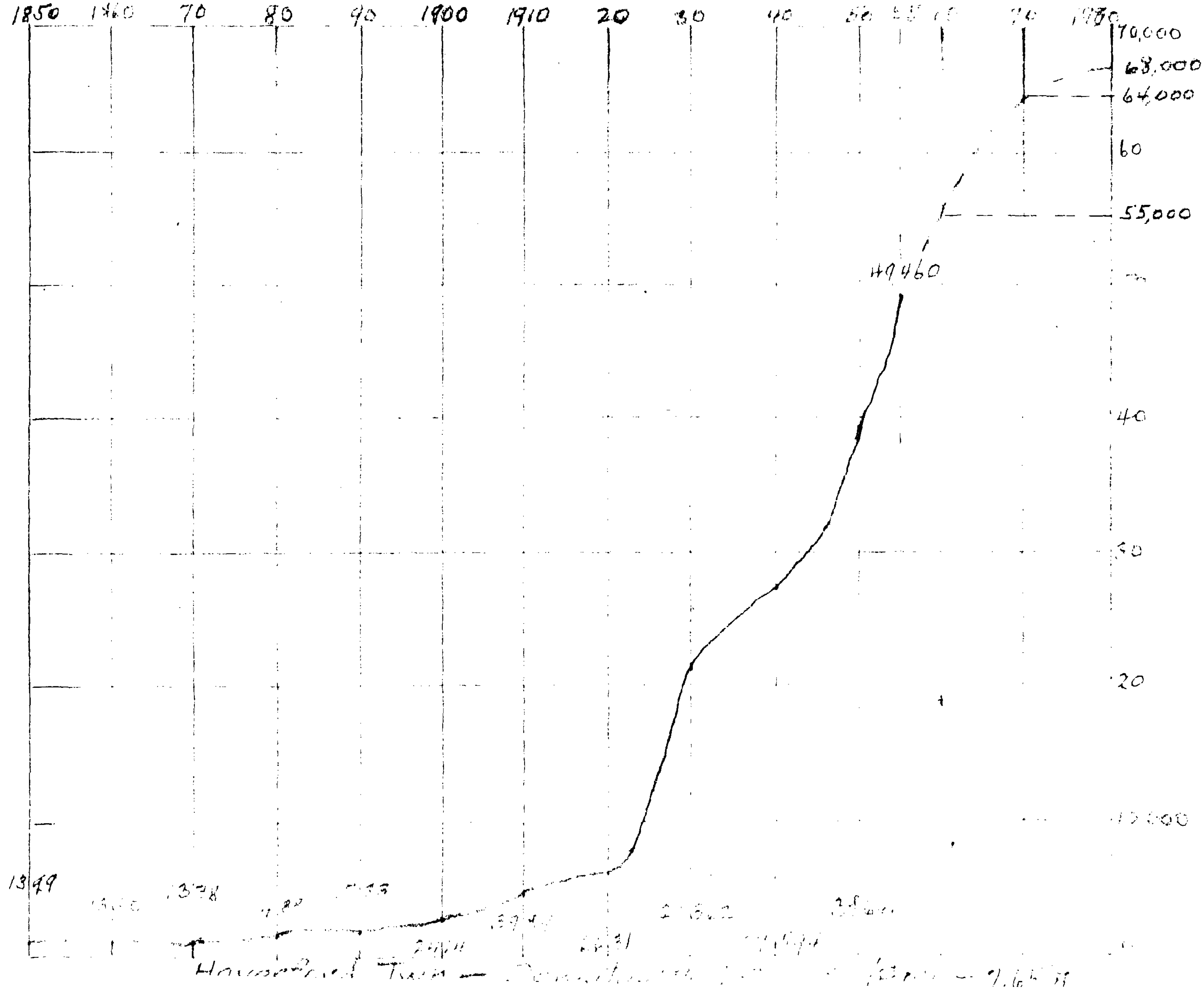


1850
60
70
80
90
1900
1910
20
30
40
50
55
60
70
1980
7,000
6
5,000
4
3,500
3
2,100
2,000
1,000
0
1280
613
647
678
648
567
552
525
474
874
1048


1850
60
70
80
90
1900
1910
20
30
40
50
55
60
70
1980
10,500
9,000
8,000
7500
7,300
6,000
5,700
4,500
4480
3,000
1,500
0
1,432
1,592
1,904



[illegible] Boro — Density - 1955 Est. - 7,960/□mi. — 12.46/A


1850
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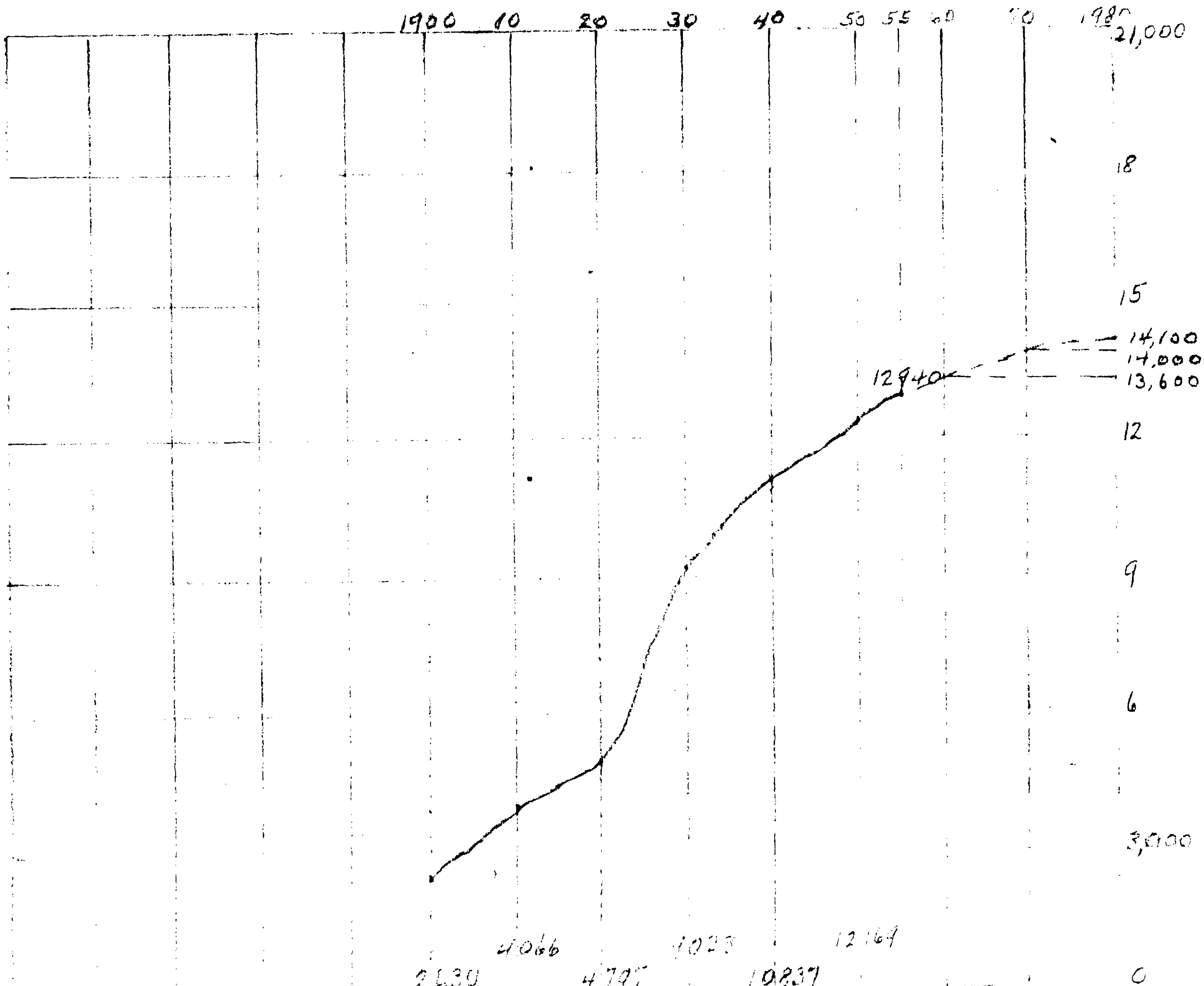
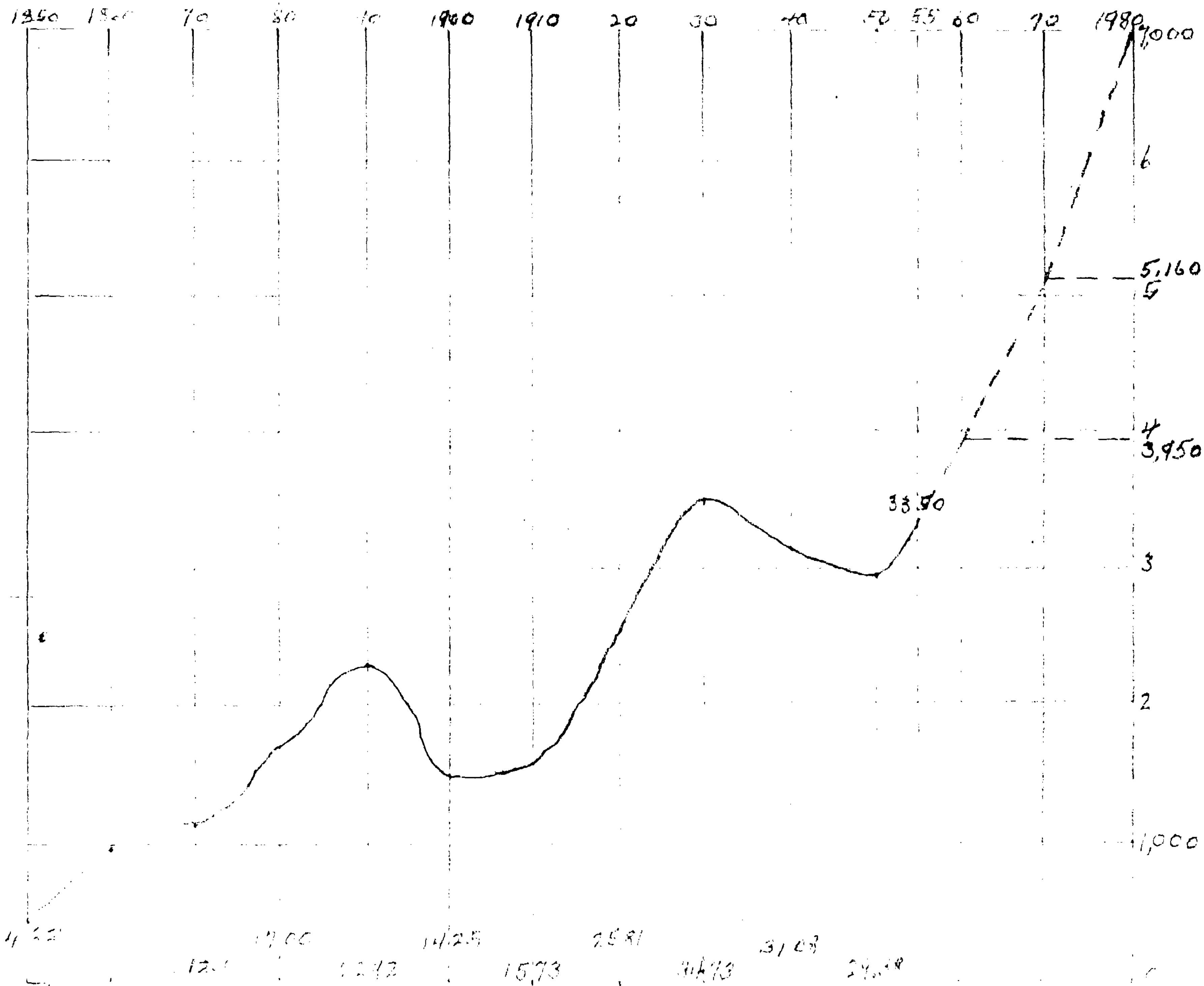
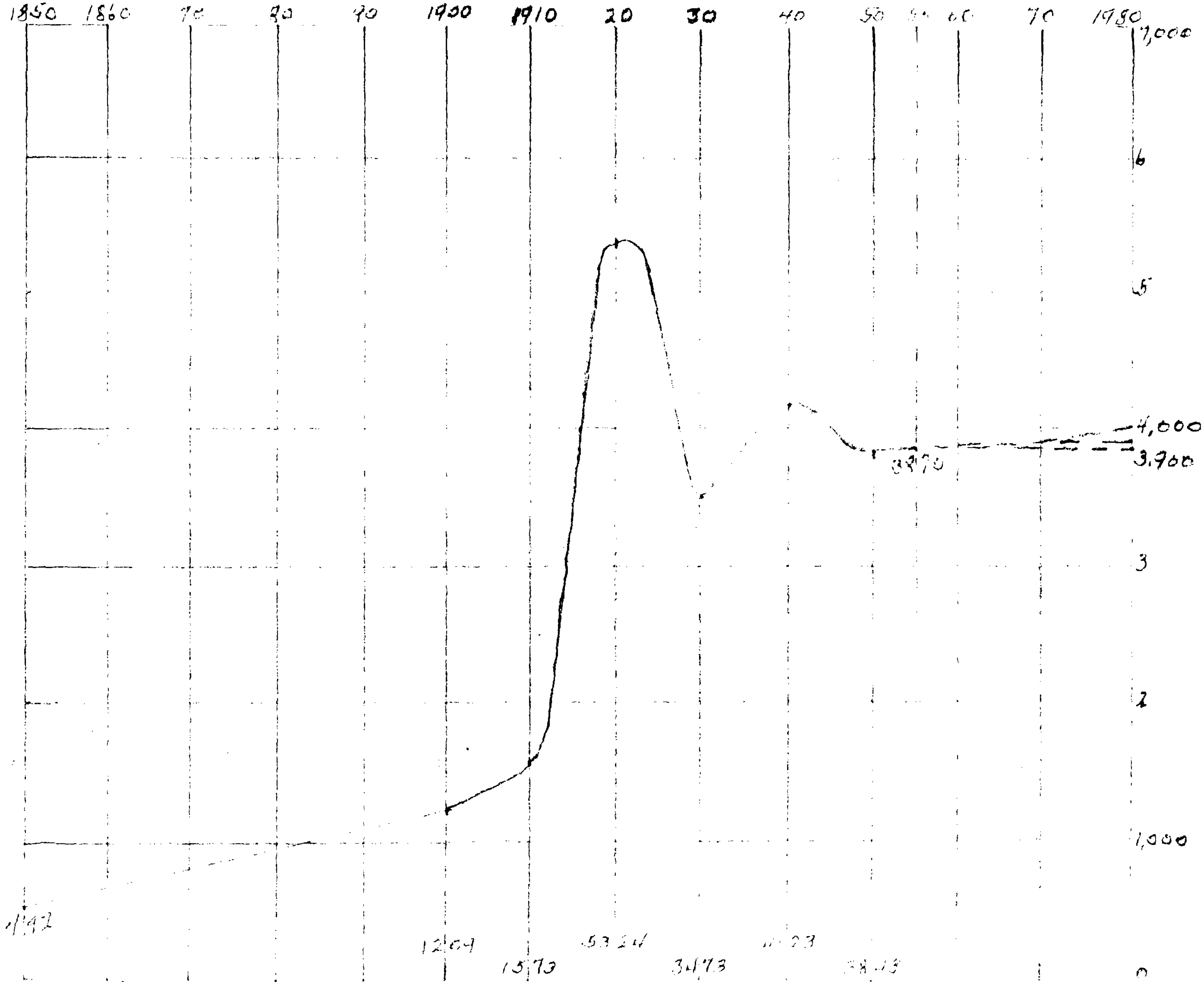
80
1900
1910
20
30
40
70,000
68,000
64,000
60
55,000
49460
40
20
1349

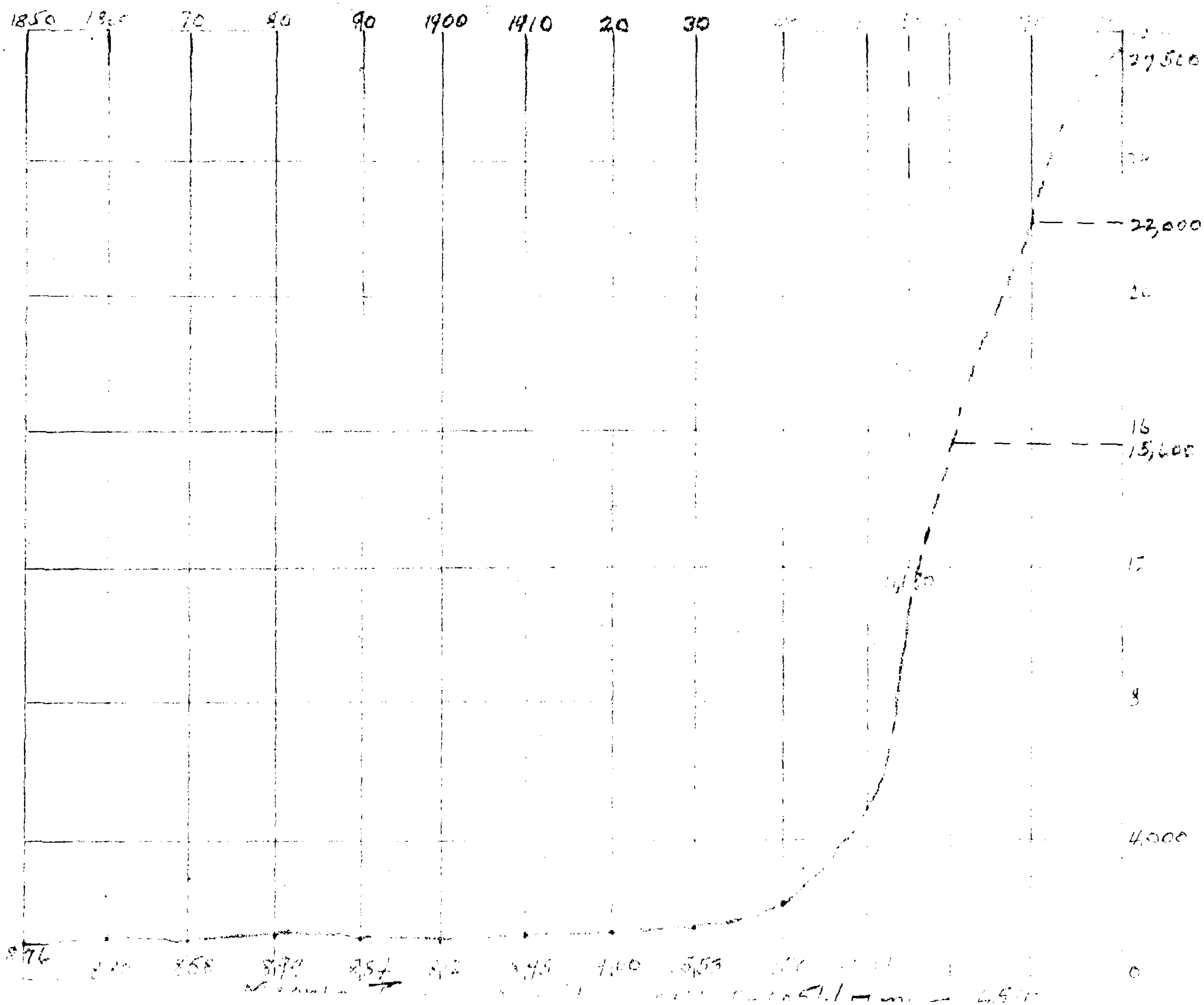


Lansdowne Boro — Density – 1955 Est. – 0.95 □mi. – 15.56

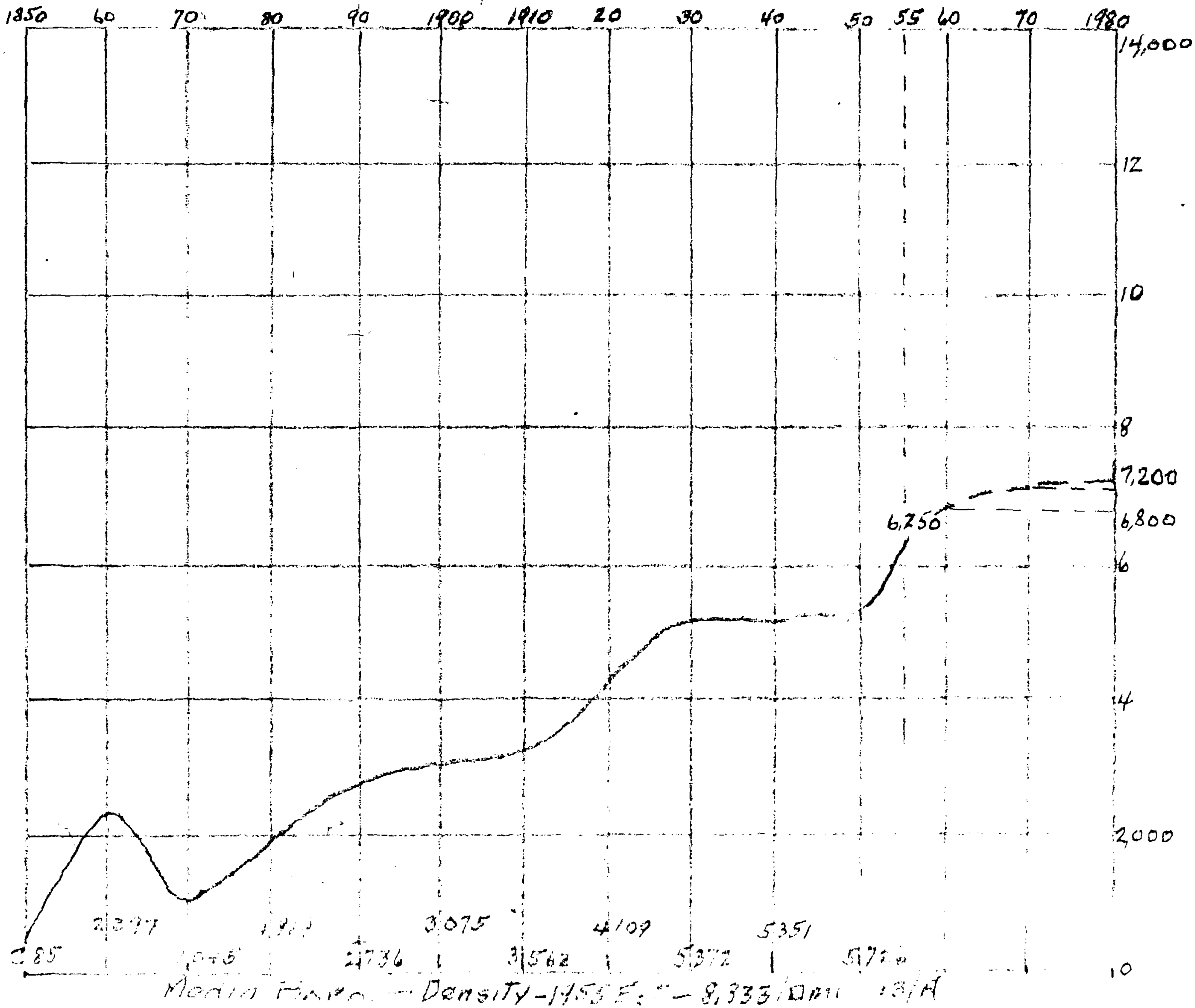

1850
70
80
1900
1910
20
30
40
55
60
70
1980
7,000
6
5,160
5
4
3,950
3350
3
2
1,000
1700
1425
2581
3103
1573



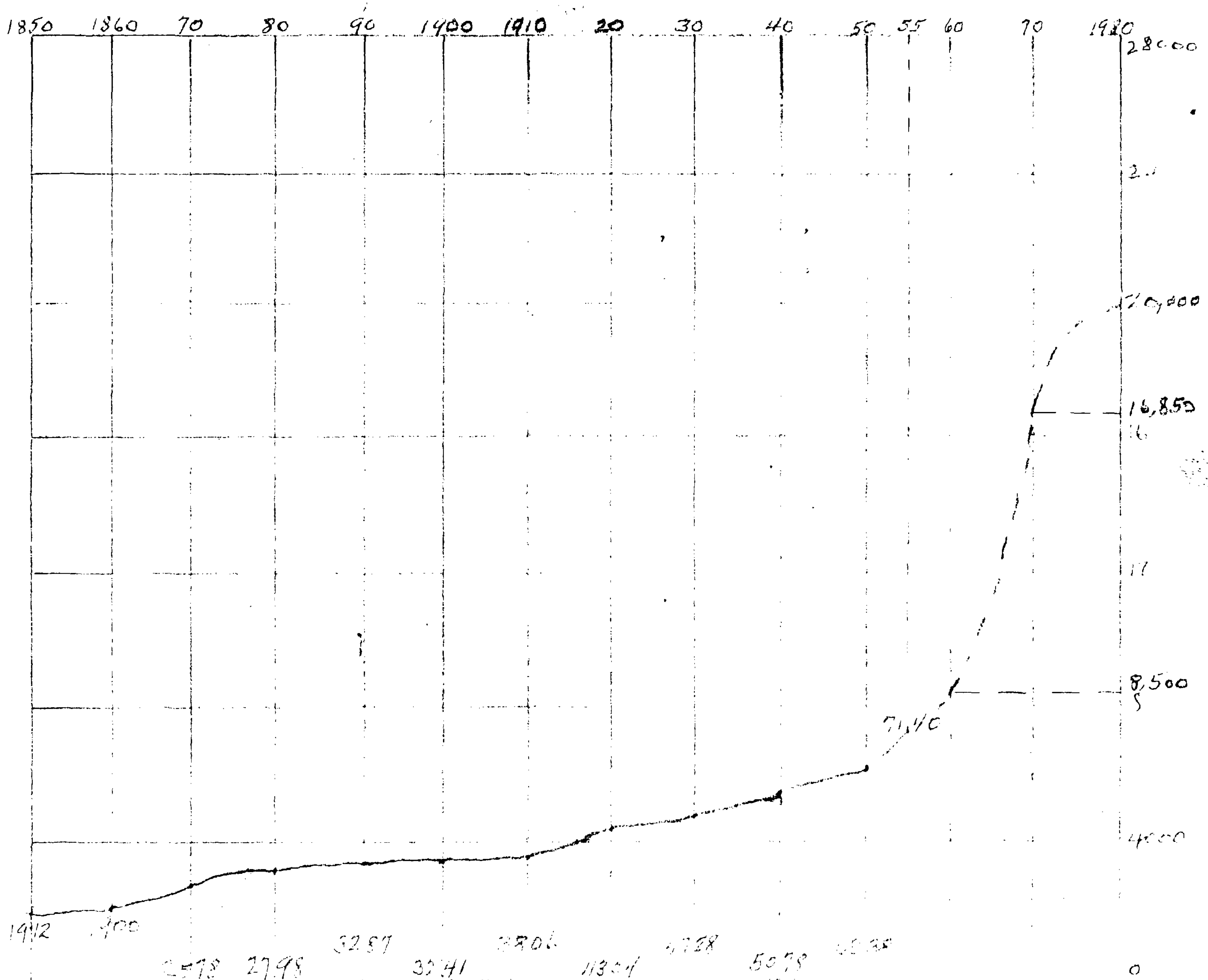
1850
1860
70
80
90
1900
1910
20
30
40
50
60
70
1980
7,000
6
5
4,000
3,900
3
2
1,000
0
3890
1204
1573
5324
3473



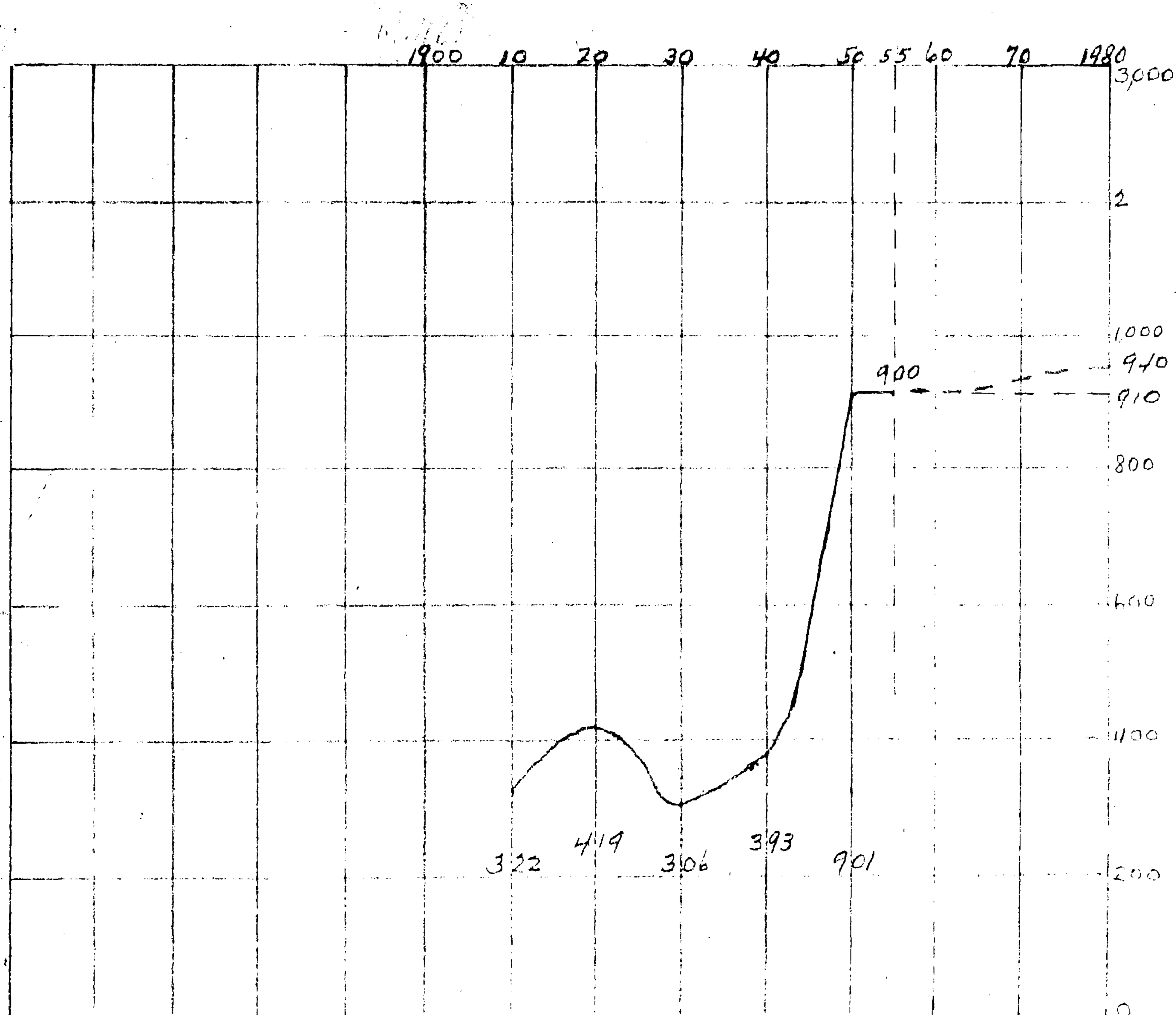
1850
70
80
90
1900
1910
20
30
27,500
22,000
20
16
15,600
4,000
0
876
858



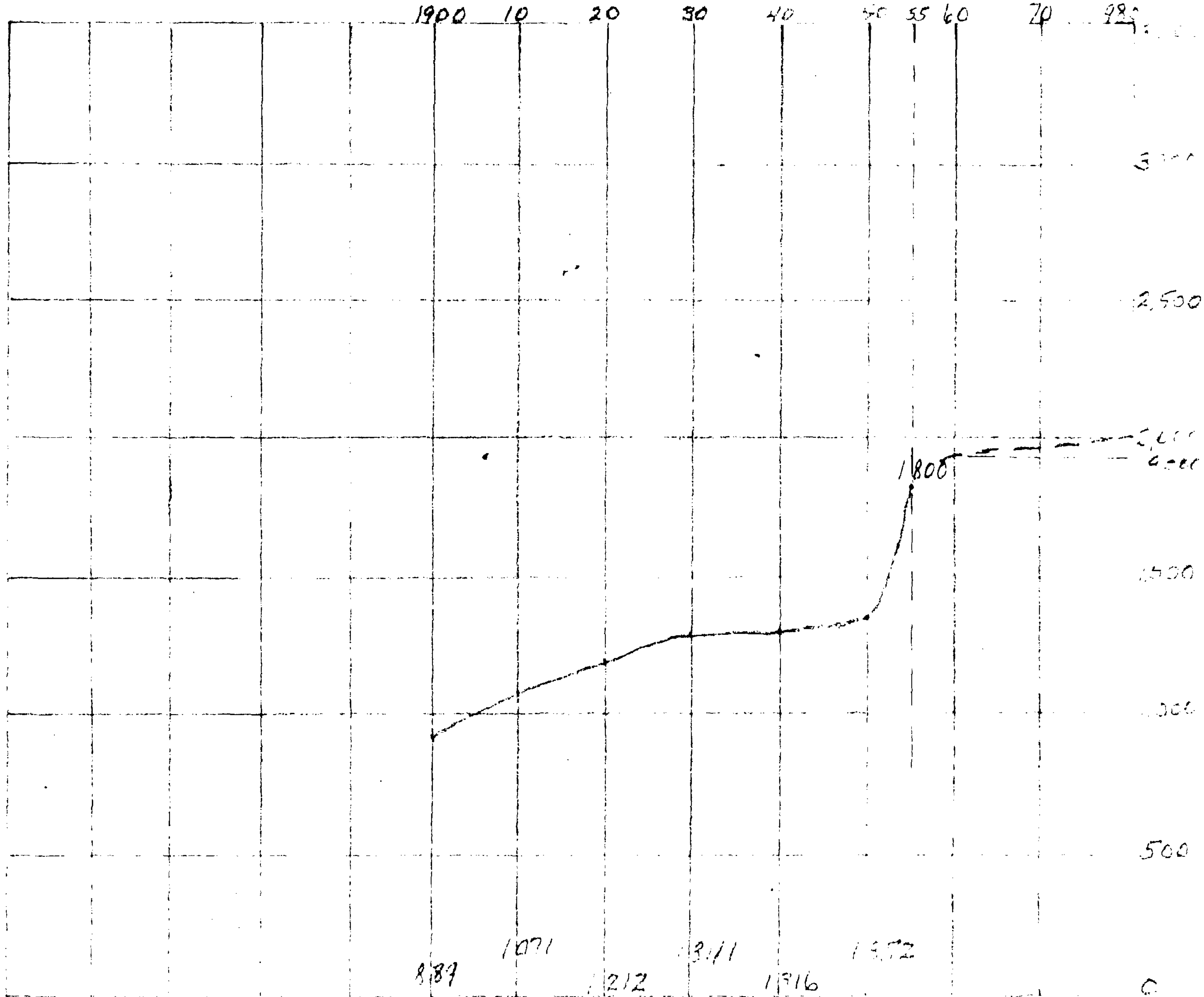
1850
60
70
80
90
1900
1910
20
30
40
50
55
60
70
1980
14,000
12
10
8
7,200
6,800
6
4
2,000
10
6,250
2377
3,075
4109
5351
2736
3562
5372



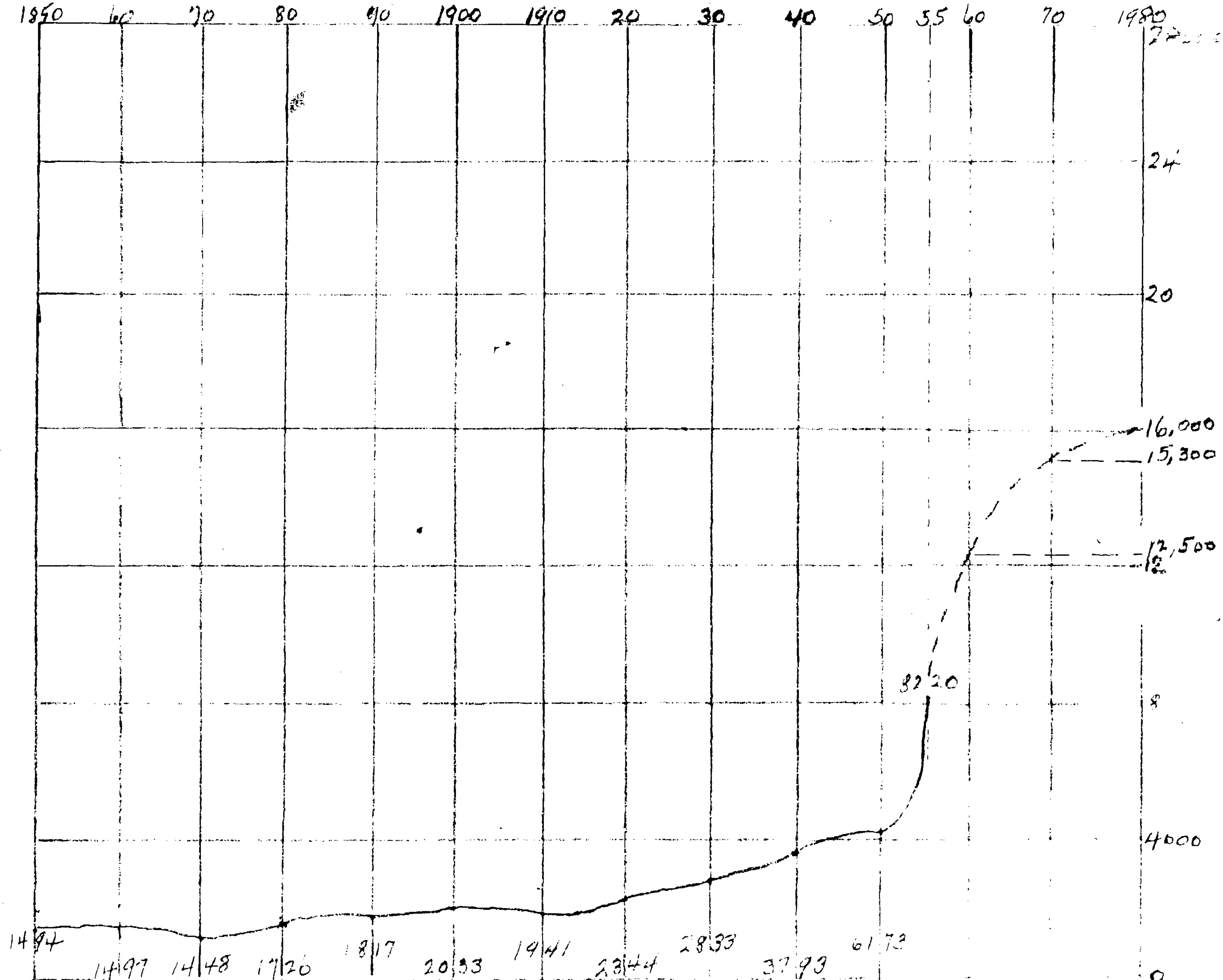
Middletown Twp



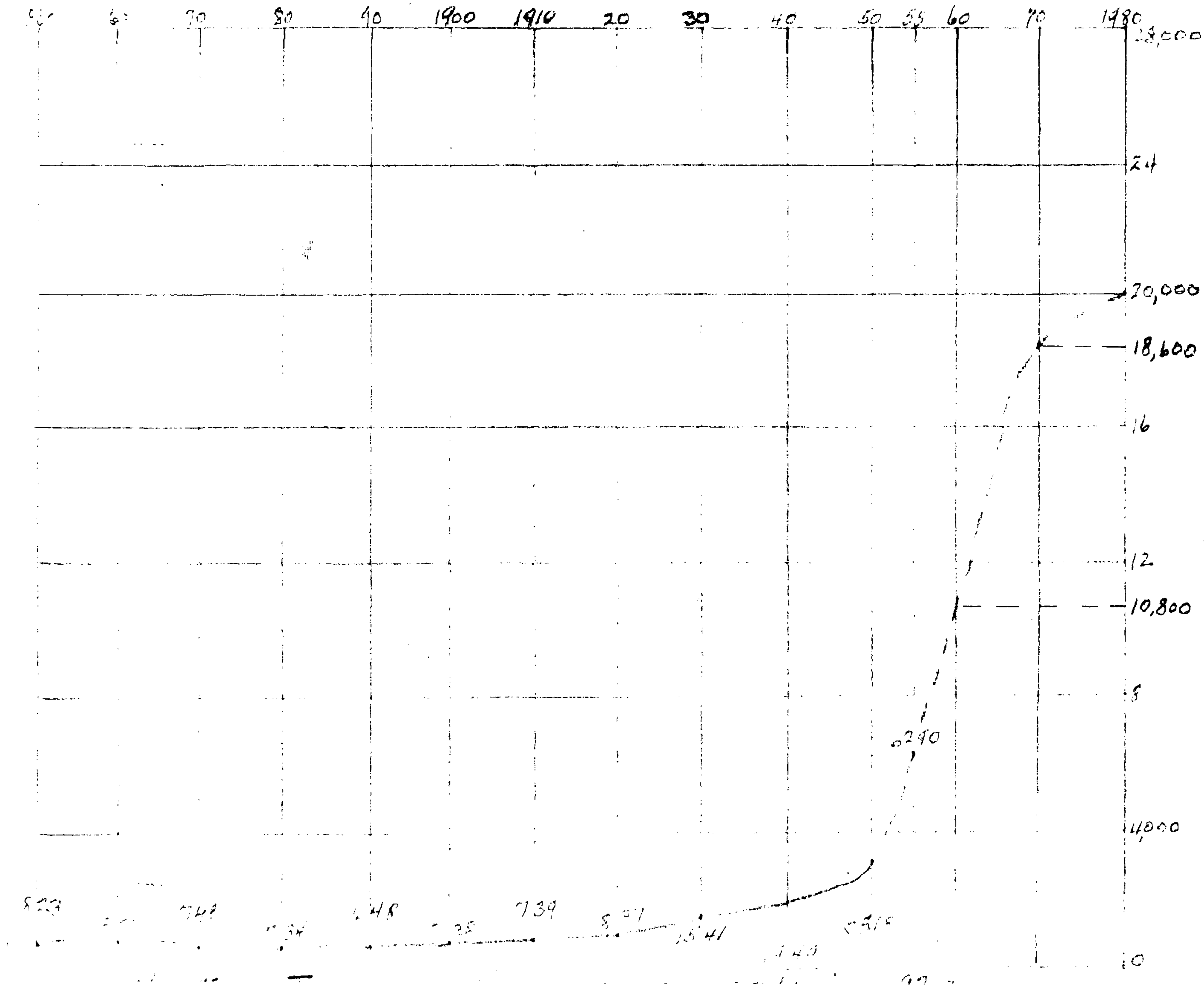
Millbourne Boro —



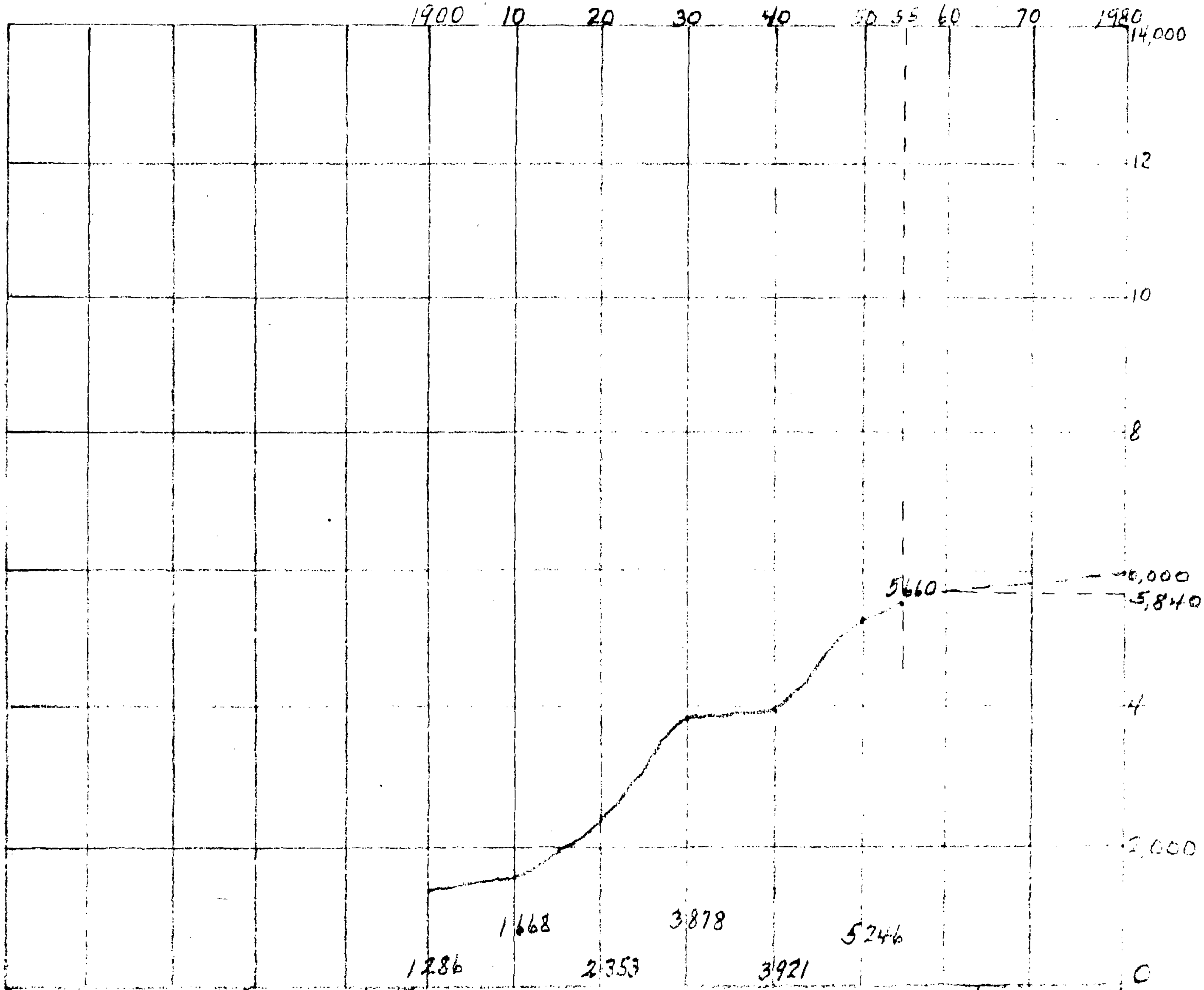
Morton Boro. — Density 1955 [illegible]



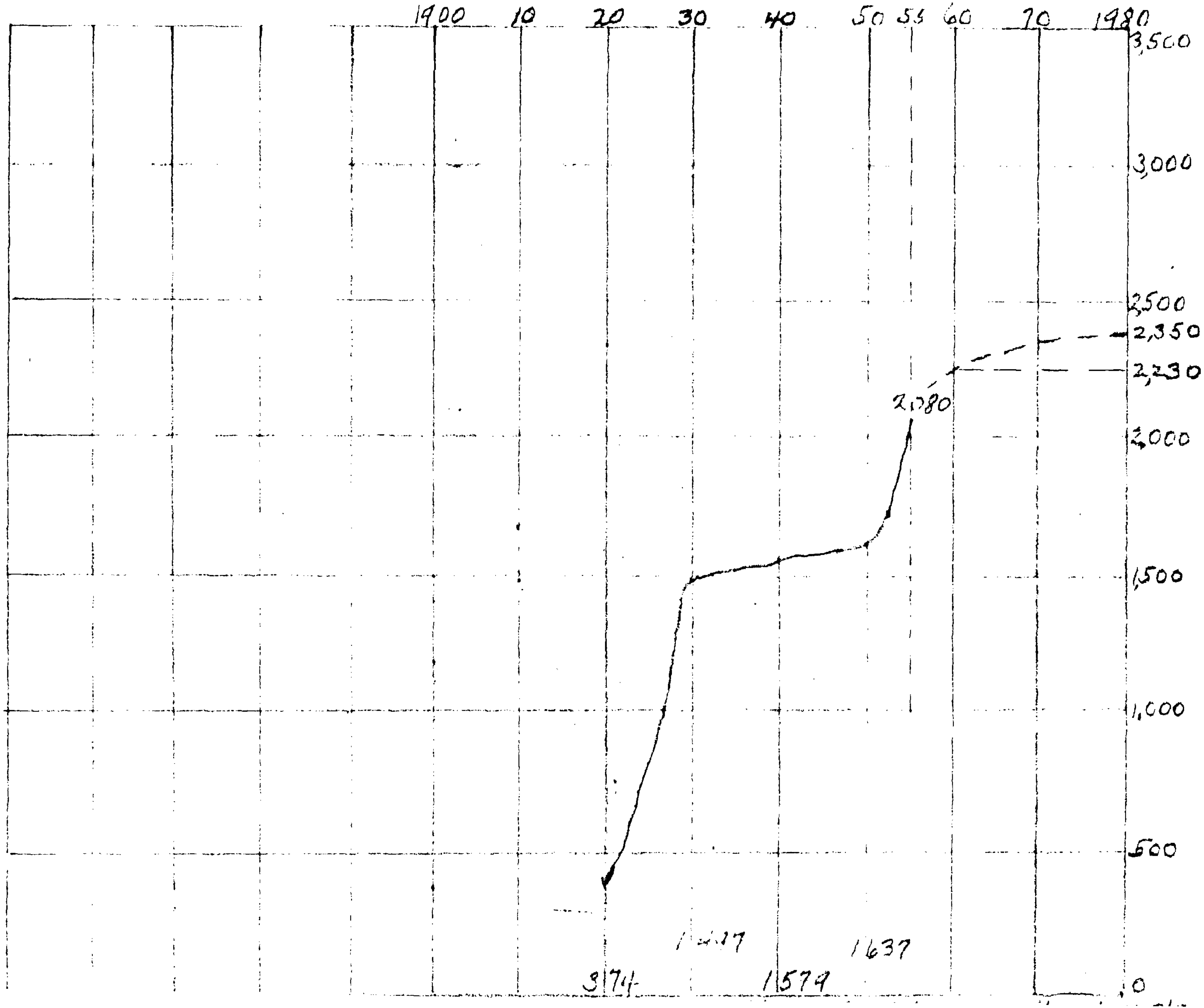
Nether Providence Twp. - [illegible] /omi - 2.80 A



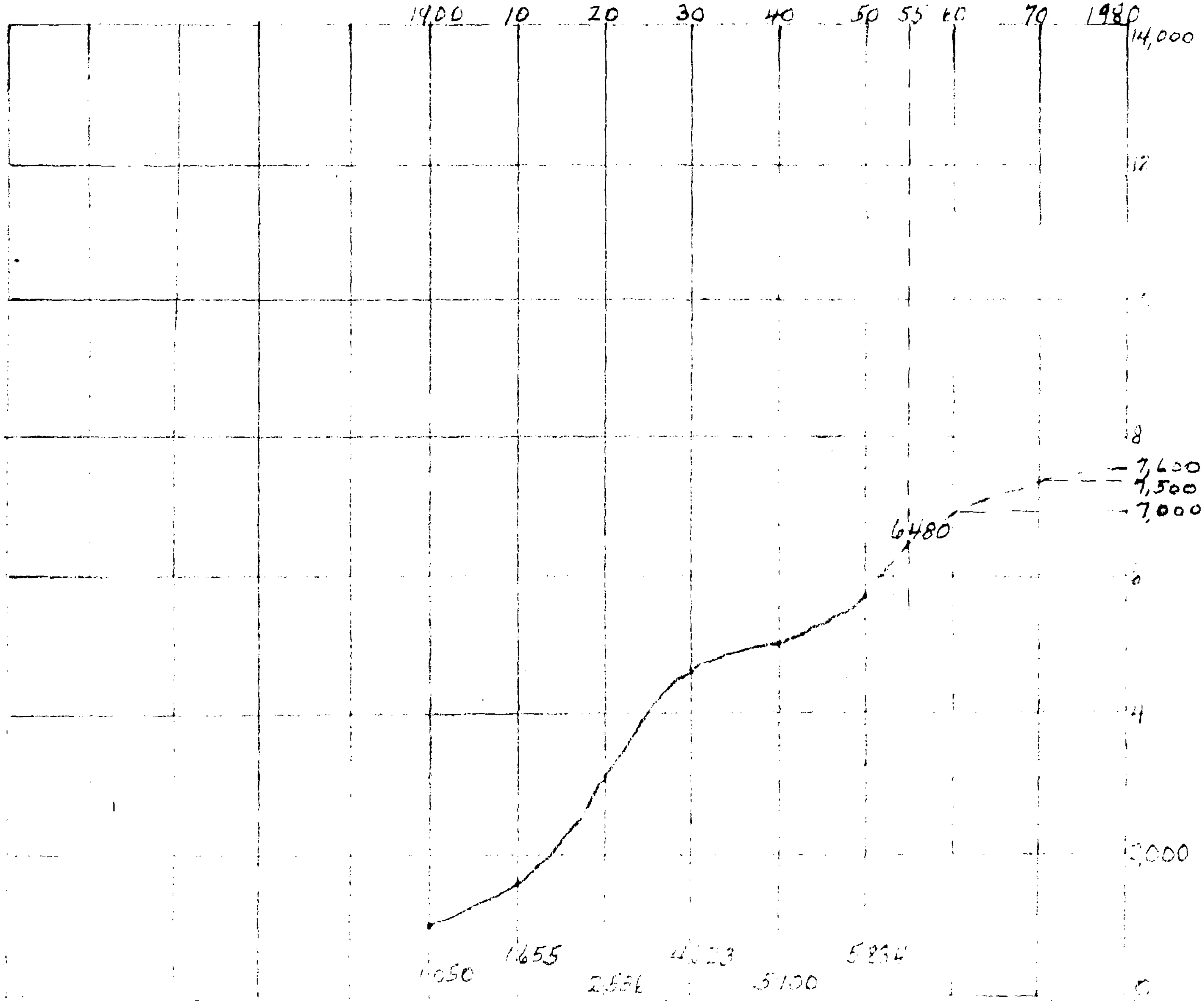
70
80
90
1900
1910
20
30
40
50
55
60
70
1980
20,000
18,600
16
12
10,800
4000



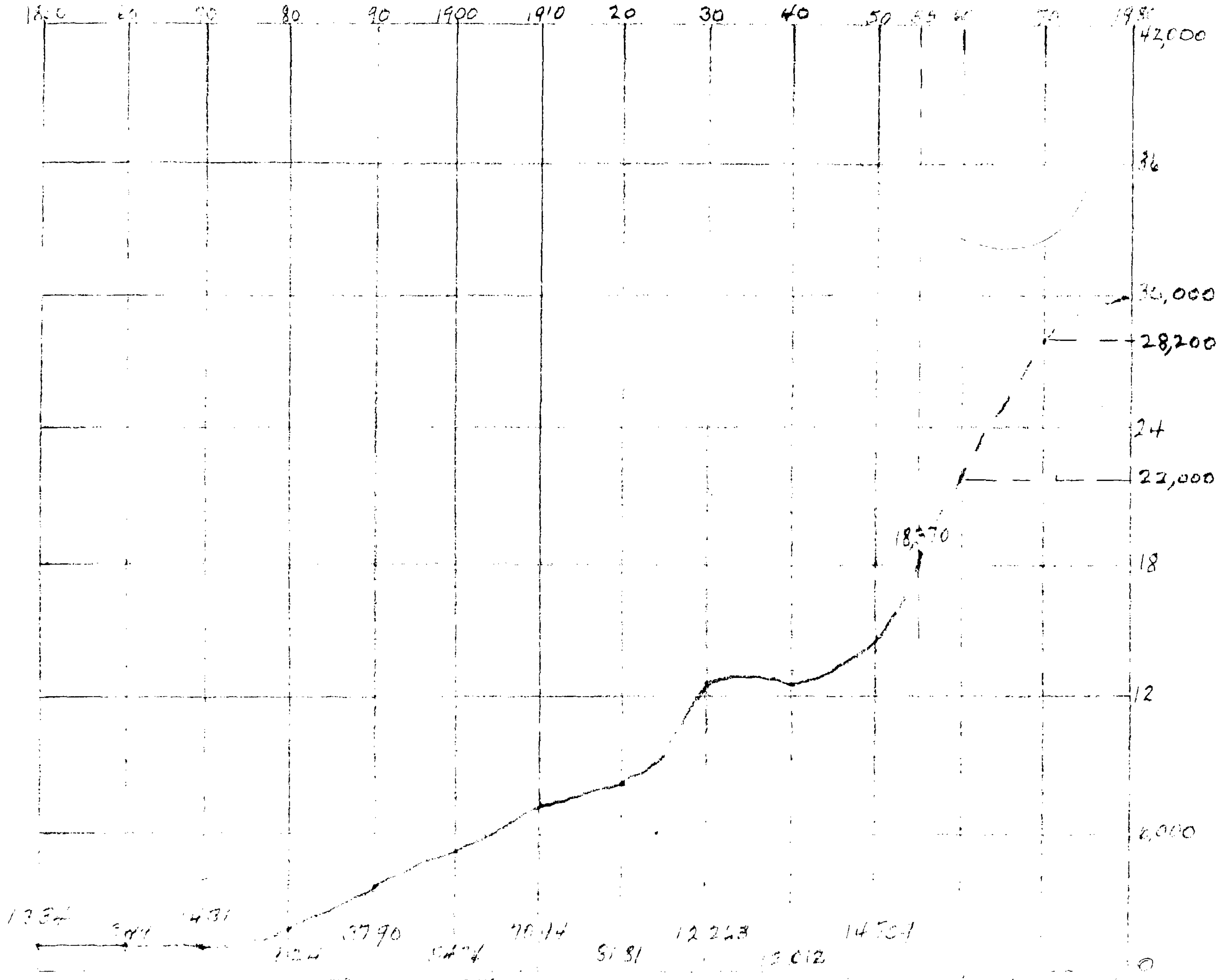
1900
10
20
30
40
50
55
60
70
1980
14,000
12
10
8
6,000
5,840
4
2,000
0
5660
1286
1668
2353
3878
3921
5246



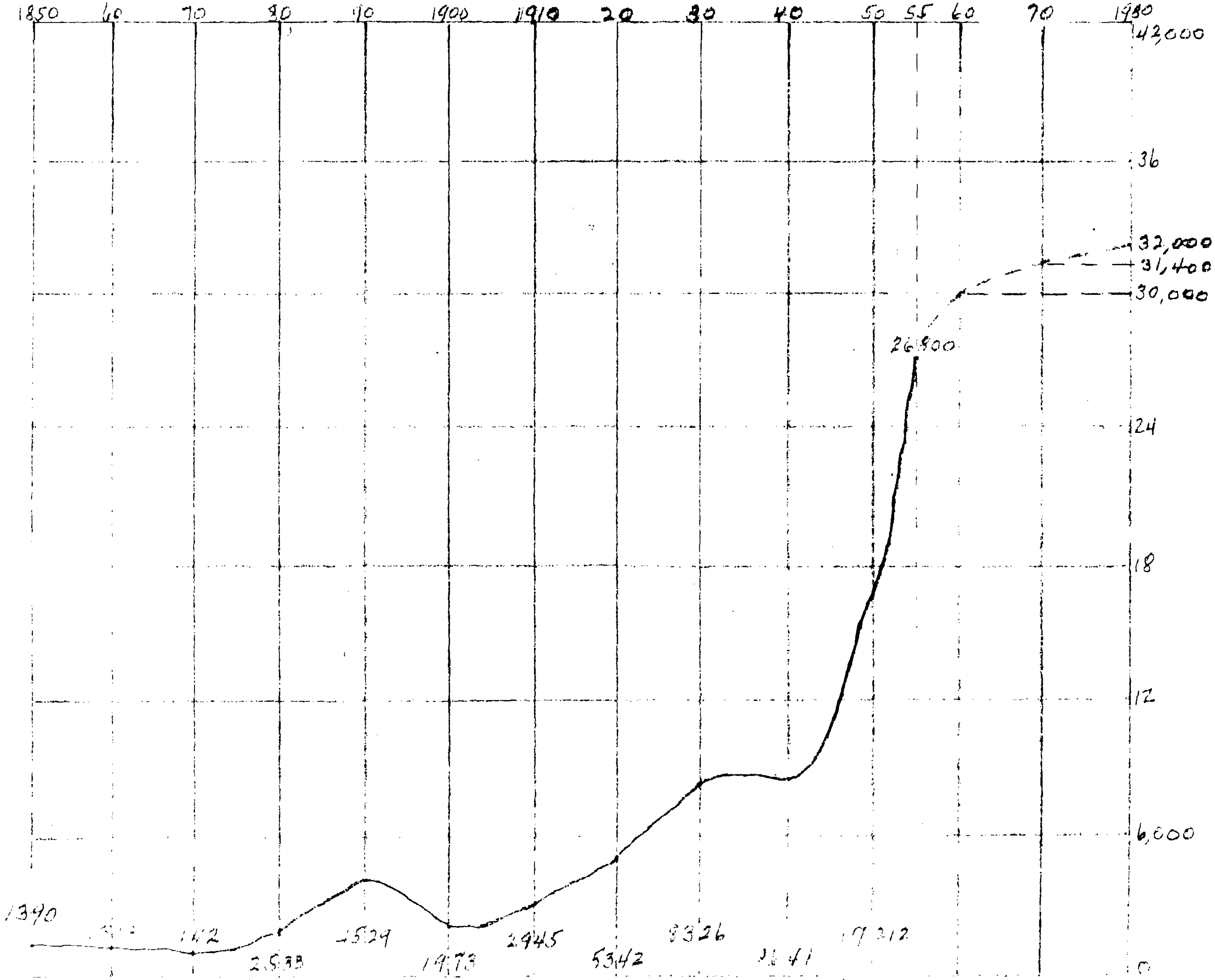
1900
10
20
30
40
50
55
60
70
1980
3,500
3,000
2500
2,350
2,230
2,080
2,000
1,500
1,000
500
0
374
1477
1579
1637



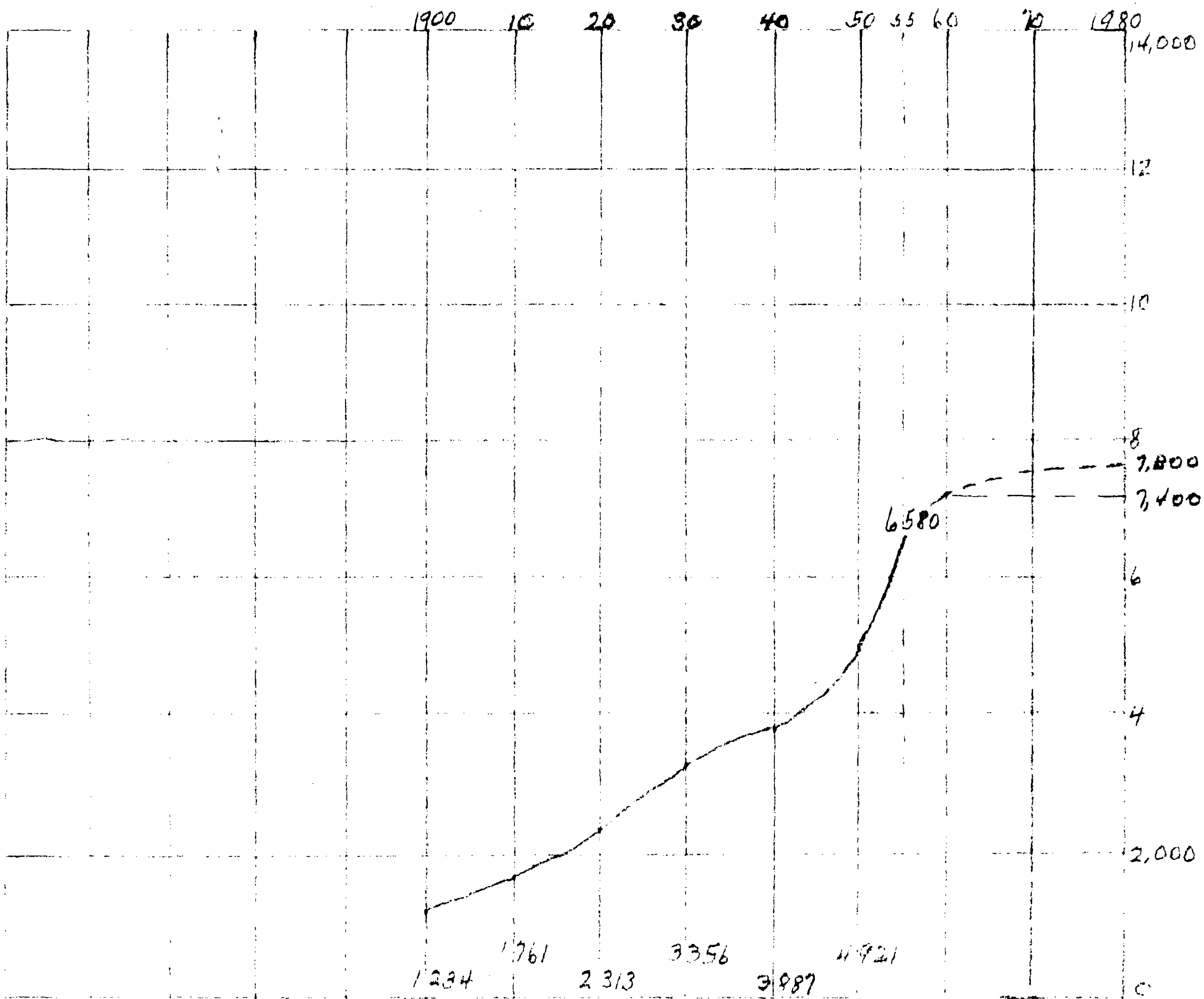
Prospect Park Boro - Density - 1955 ... .640 □mi. - 13.5 A



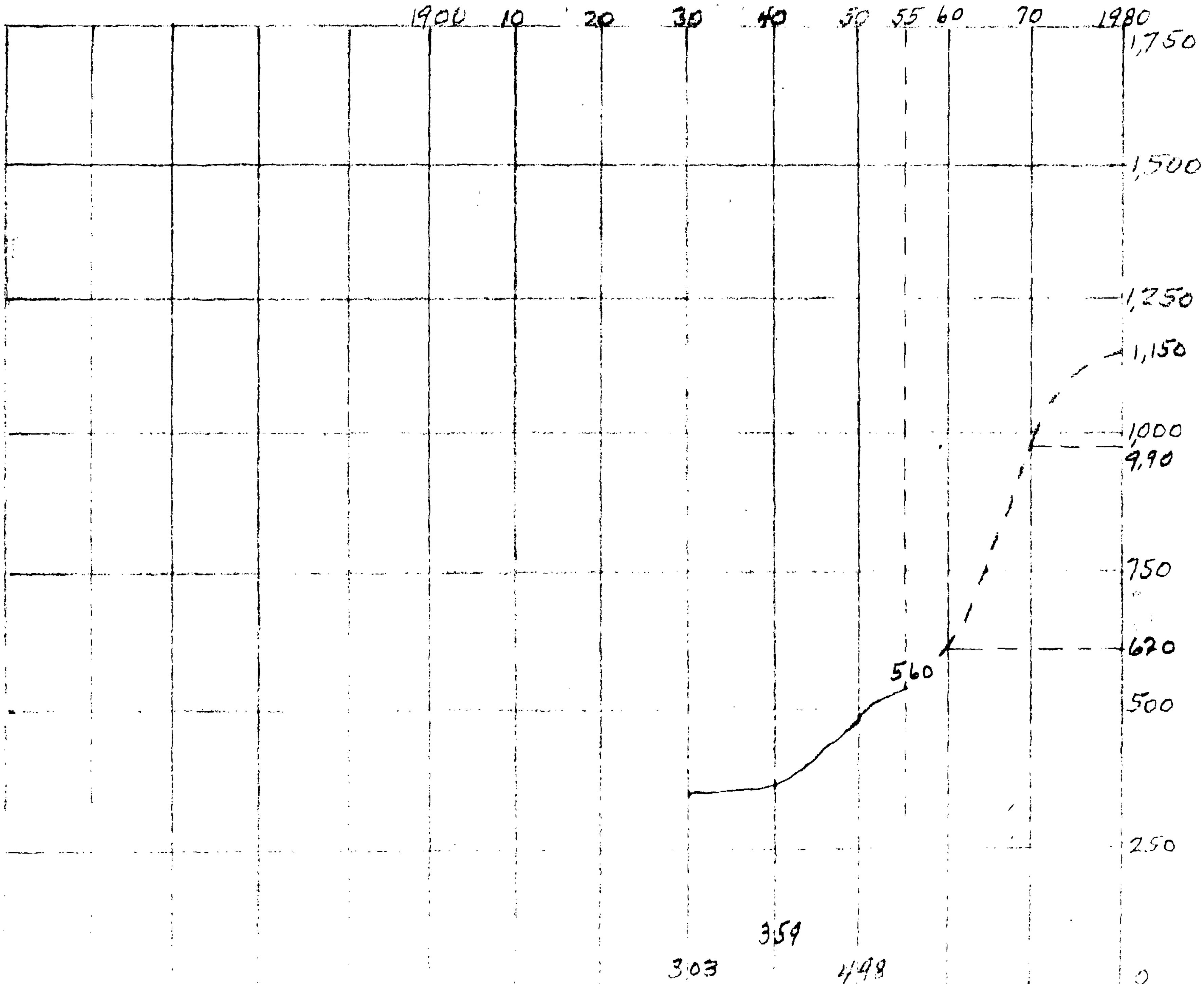
80
90
1900
1910
20
30
40
50
42,000
36
30,000
28,200
24
22,000
18,570
18
12
6,000
0
3790
7044
5181
12,243
13,012
14,504



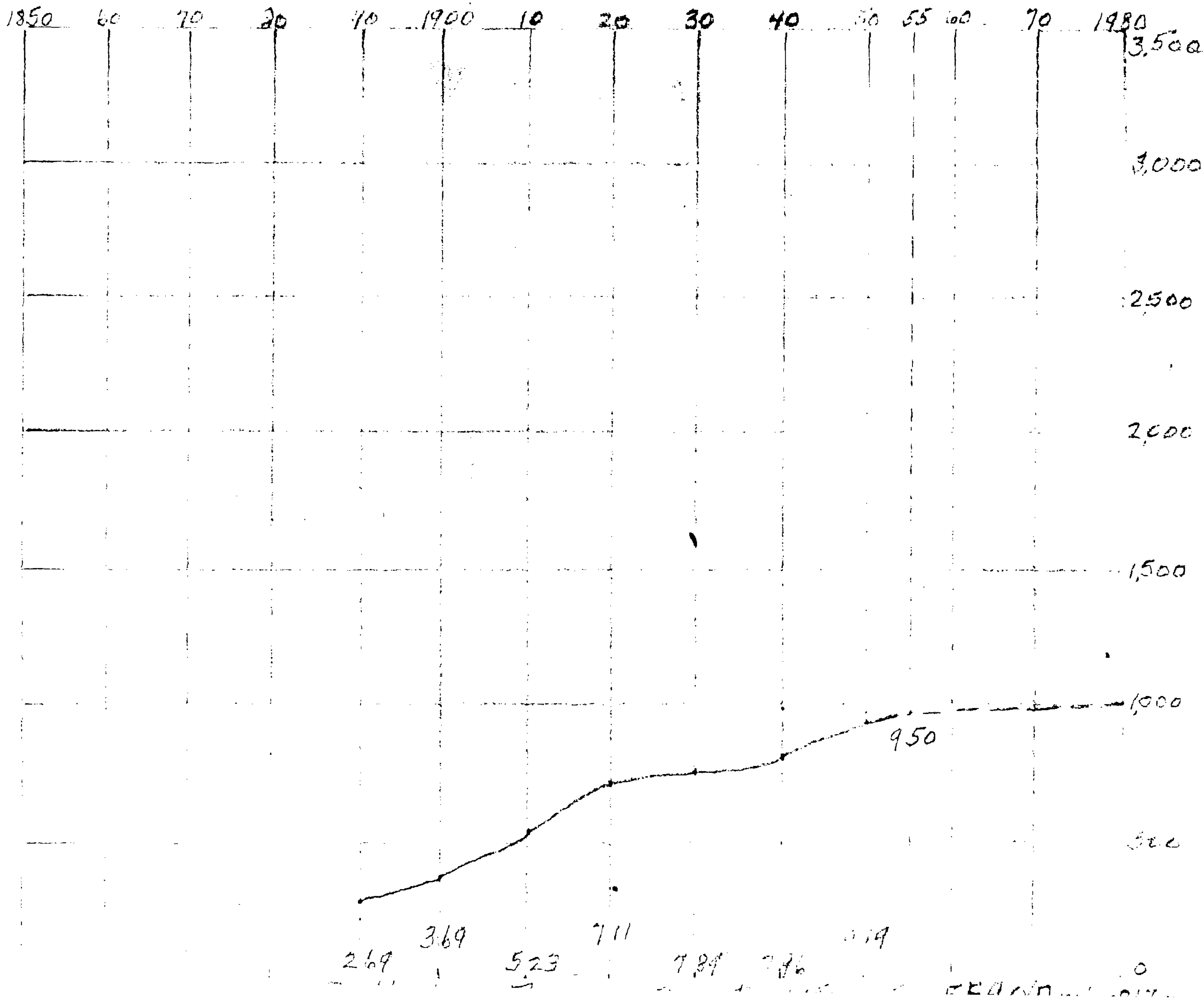
Ridley Twp — Density 1955 Est. — 4,620/sq. m. — 7.22 sq. m.



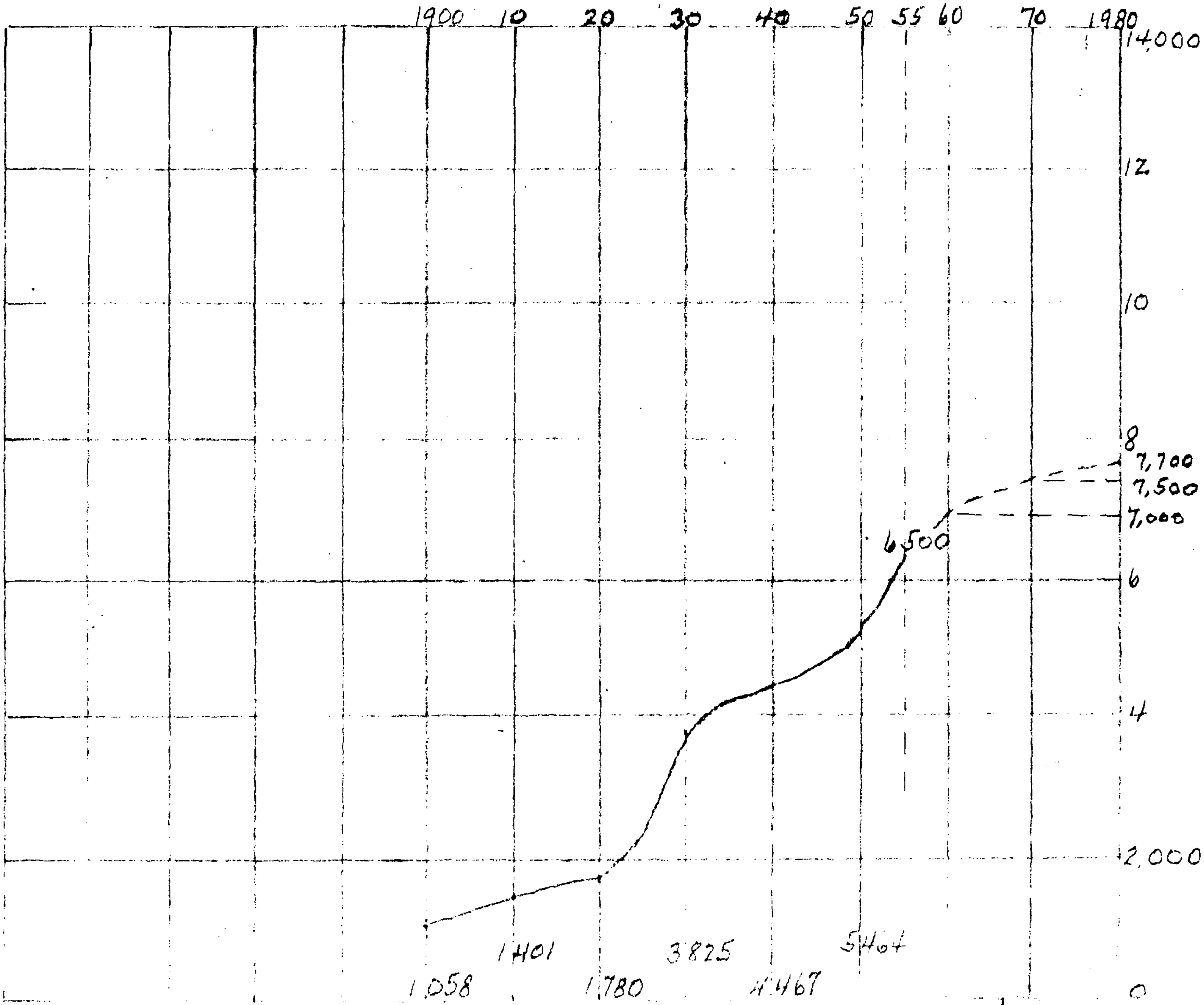
1900
10
20
30
40
50
55
60
70
1980
14,000
12
10
8
7,800
7,400
6580
6
4
2,000
0
1761
3356
4921
1234
2313
3987



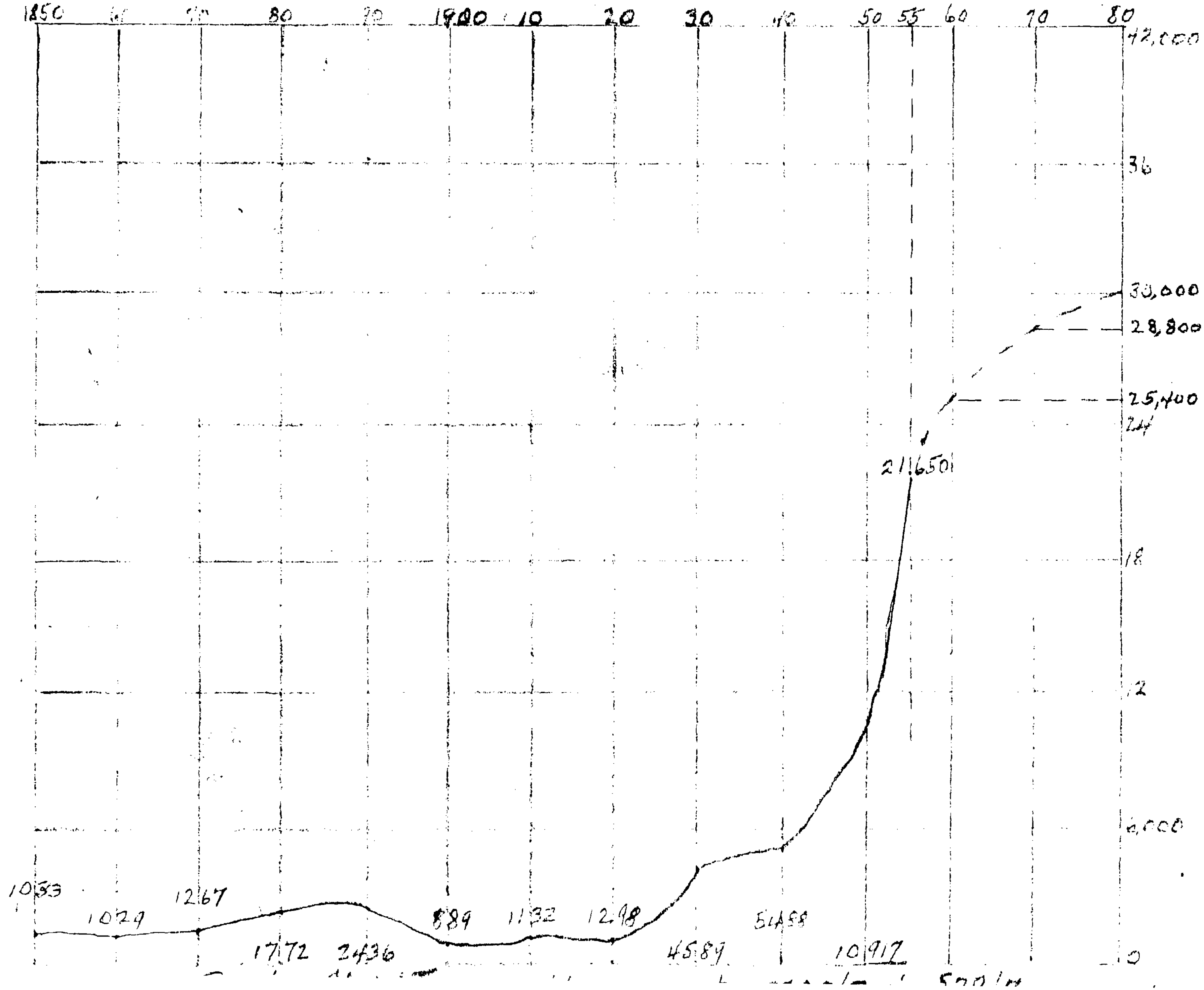
Rose Valley Boro – Density – 1955 Est – 874/□mi, – 1.59/A

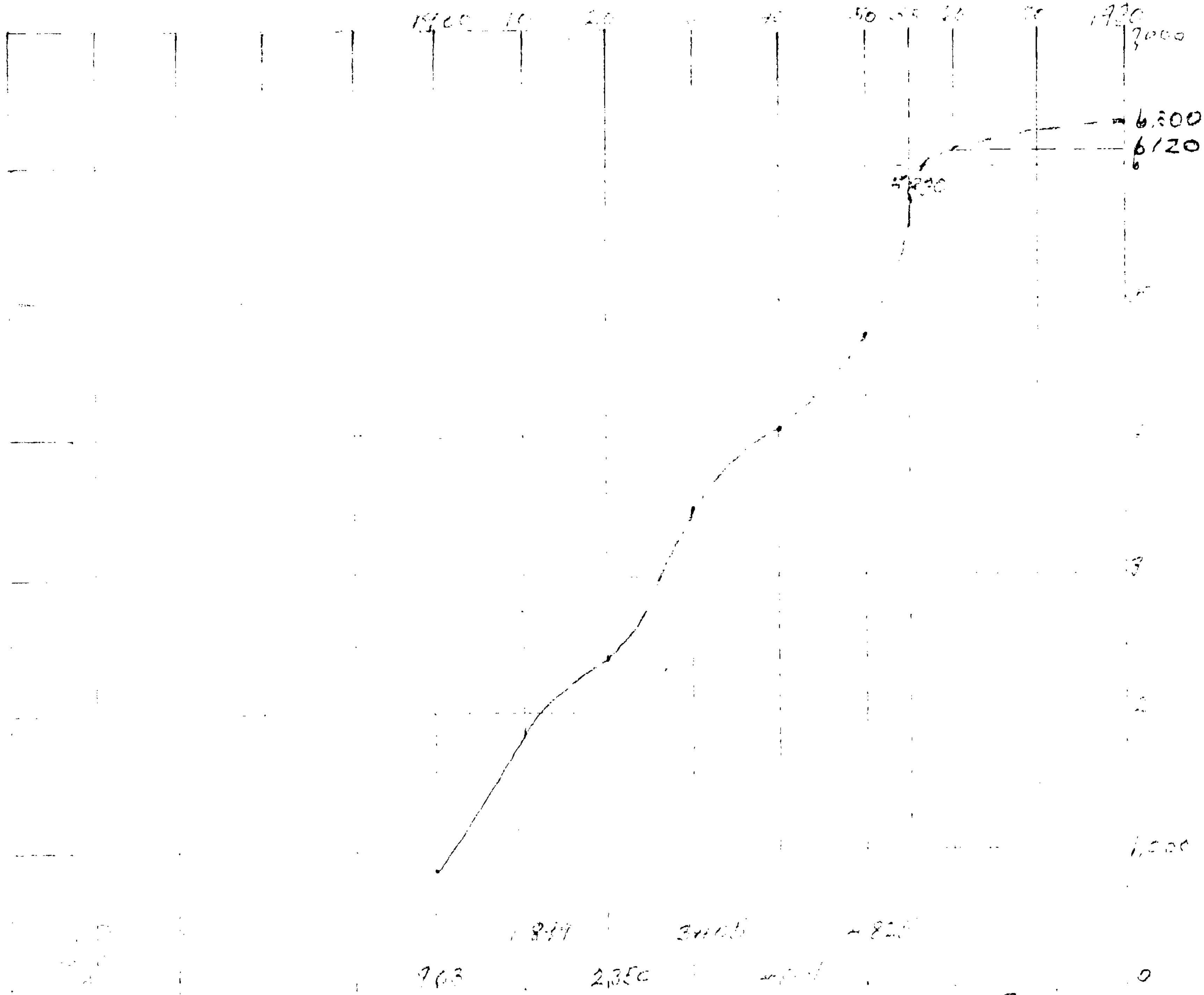


1850
60
70
80
90
1900
10
20
30
40
50
55
60
70
1980
3,500
3,000
2,500
2,000
1,500
1,000
500
0
950
269
369
523
711
784
786

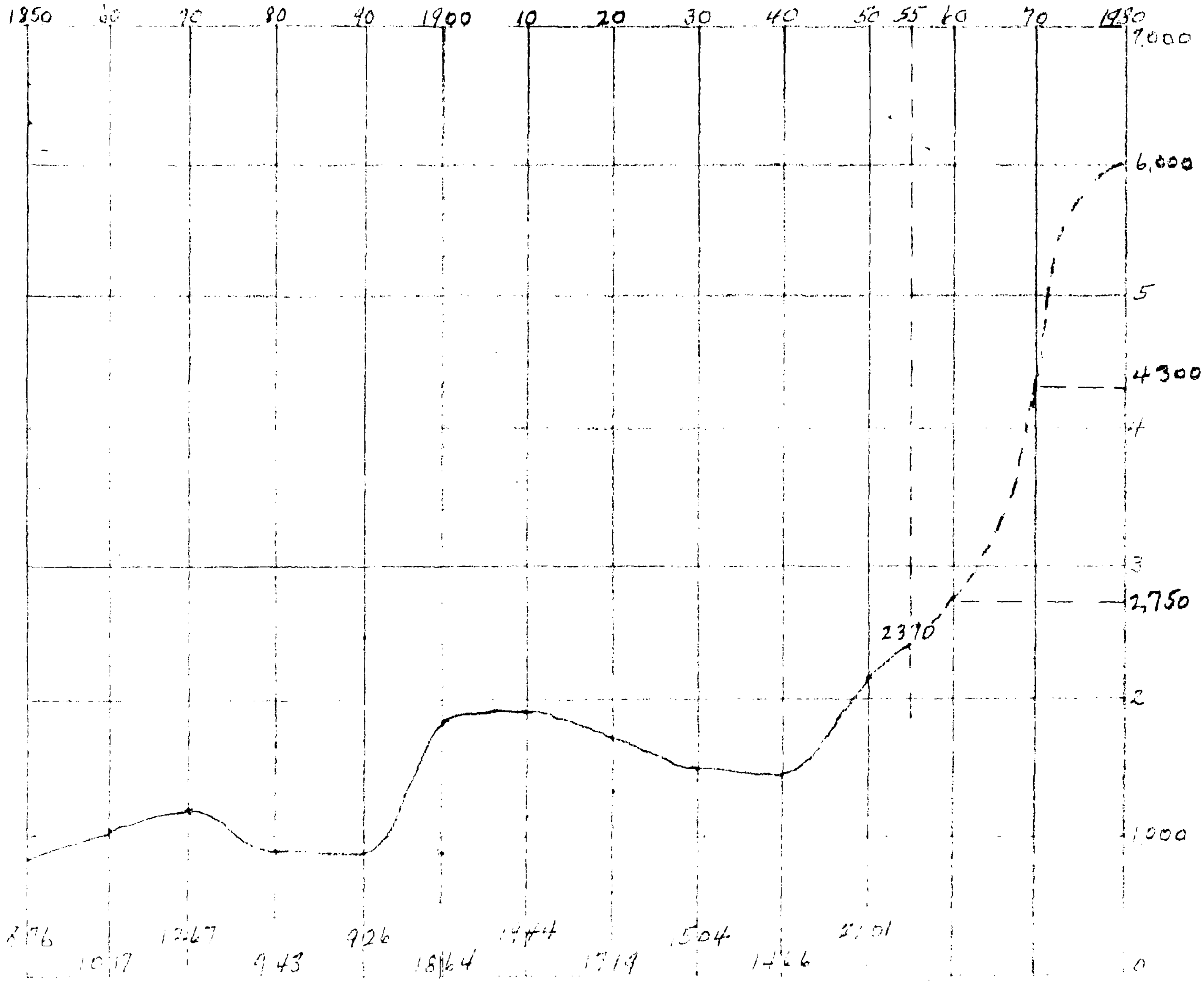


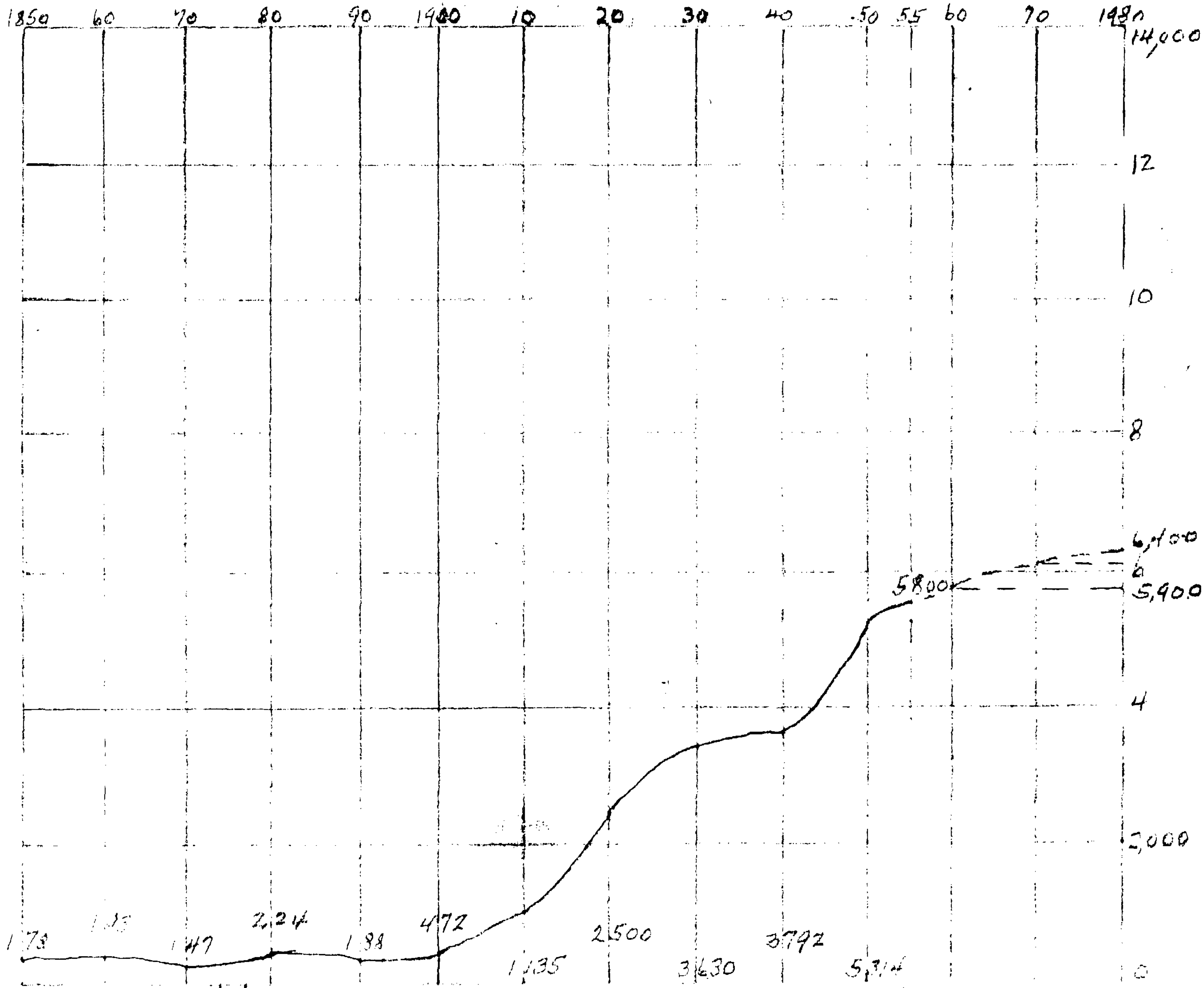
Sharon Hill Boro. – Density 1955 Est. 7,780/□mi.–12.15/A


1850
60
70
80
90
1900
10
20
30
40
50
55
60
70
80
42,000
36
30,000
28,800
25,400
24
18
12
6,000
0
1053
1029
1267
1772
2436
889
1132
1298
4589
5158
10917
21650



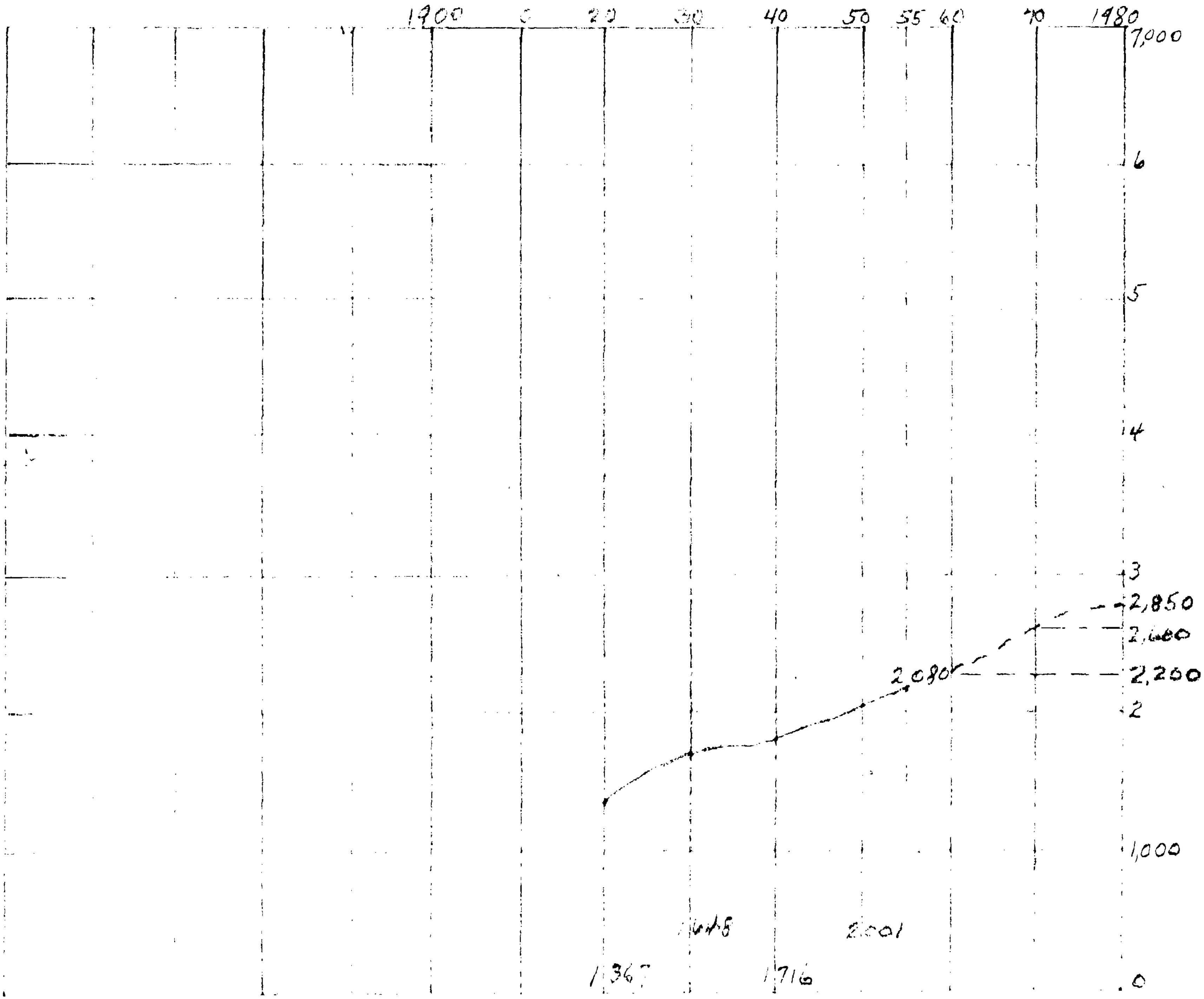
Swarthmore Boro. -- Density ... 4,02? per ...

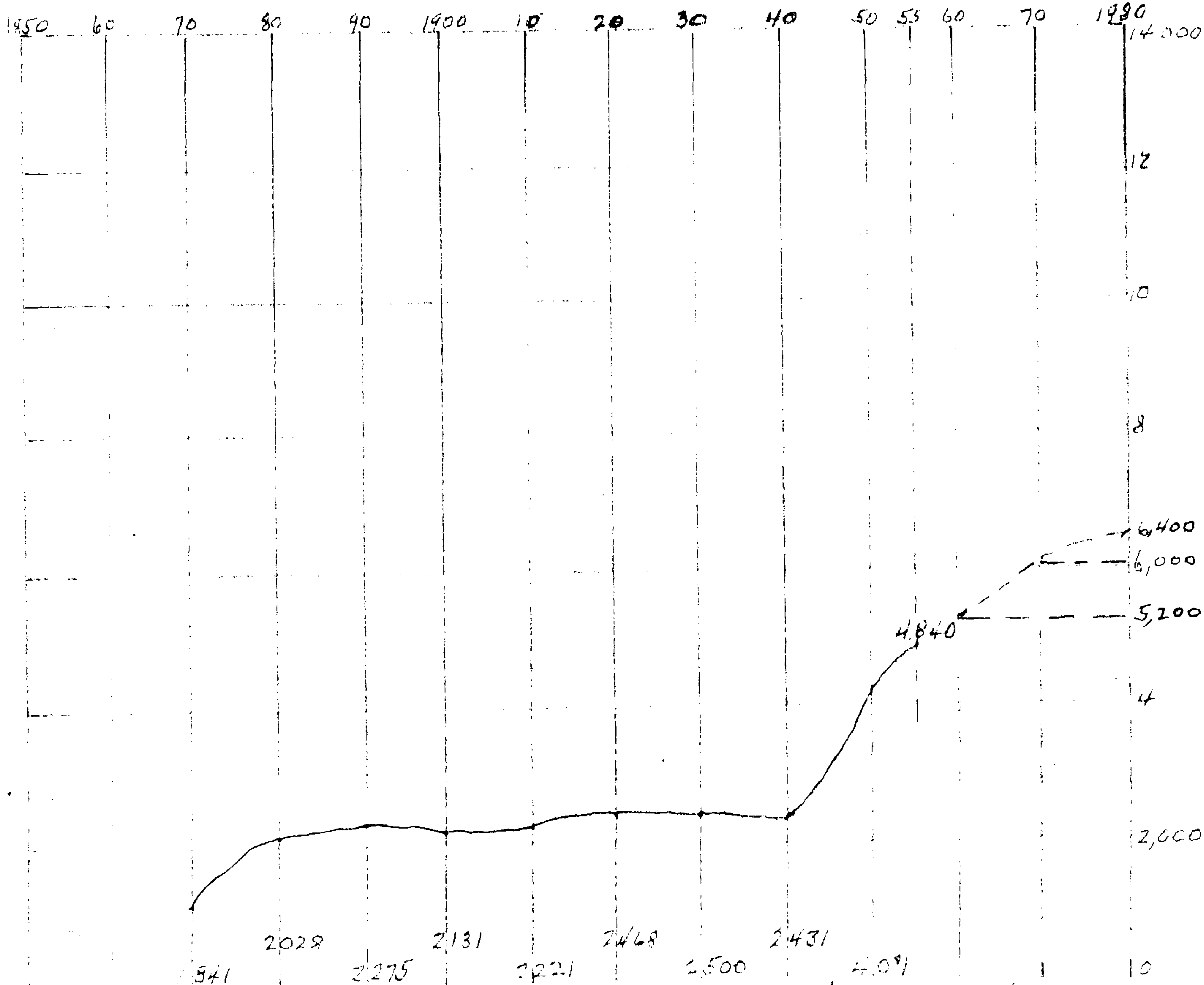

1850
60
70
80
90
1900
10
20
30
40
50
55
60
70
1980
7,000
6,000
5
4300
4
3
2,750
2370
2
1,000
0
876
1017
1267
943
926
1864
1944
1719
1504
1466
2101



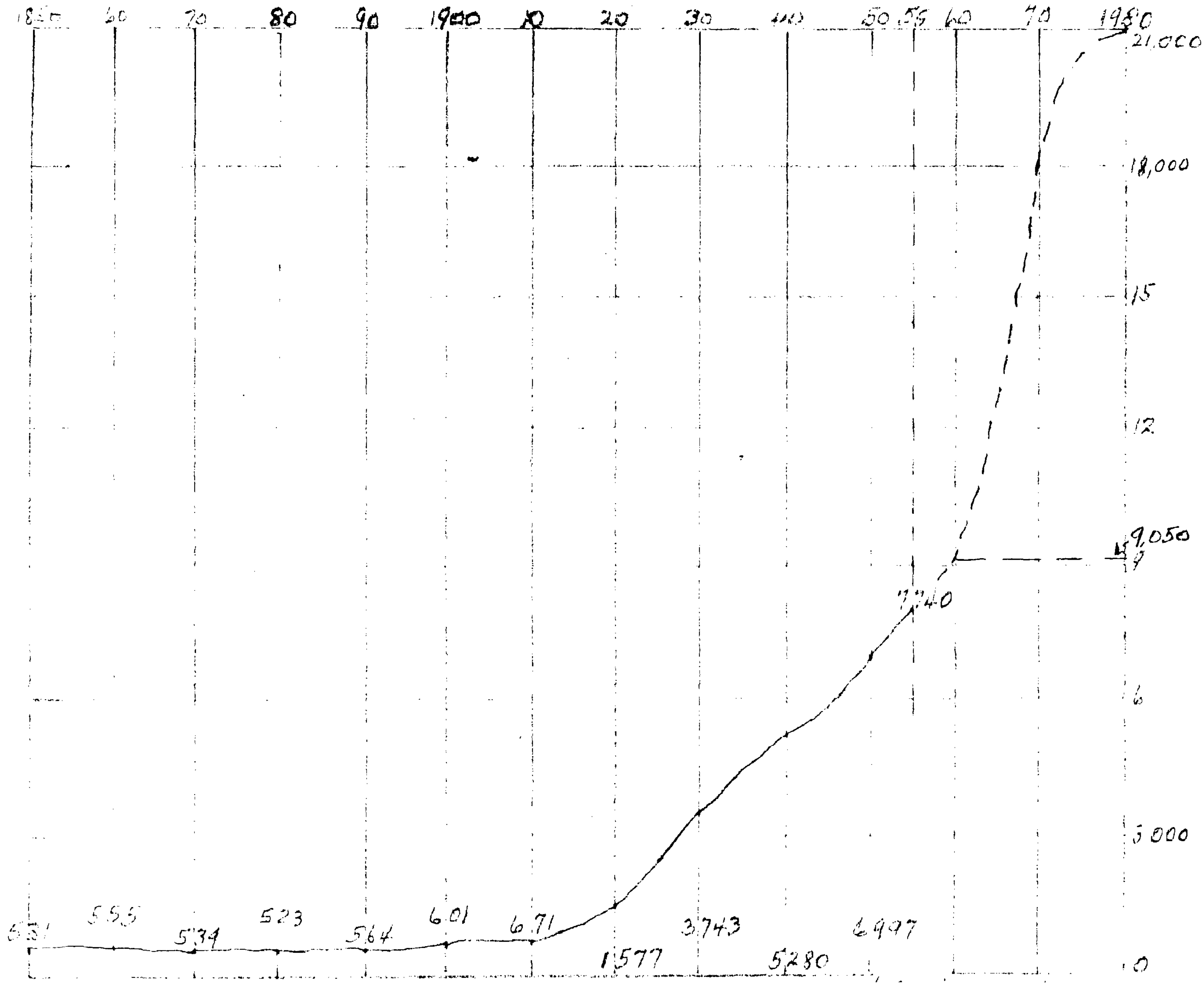
1850
60
70
80
90
1900
10
20
30
40
50
55
60
70
1980
14,000
12
10
8
6,400
6
5,900
5800
4
2,000
0
173
183
147
224
188
472
1135
2500
3630
3792
5314

Tinicum Twp [illegible]

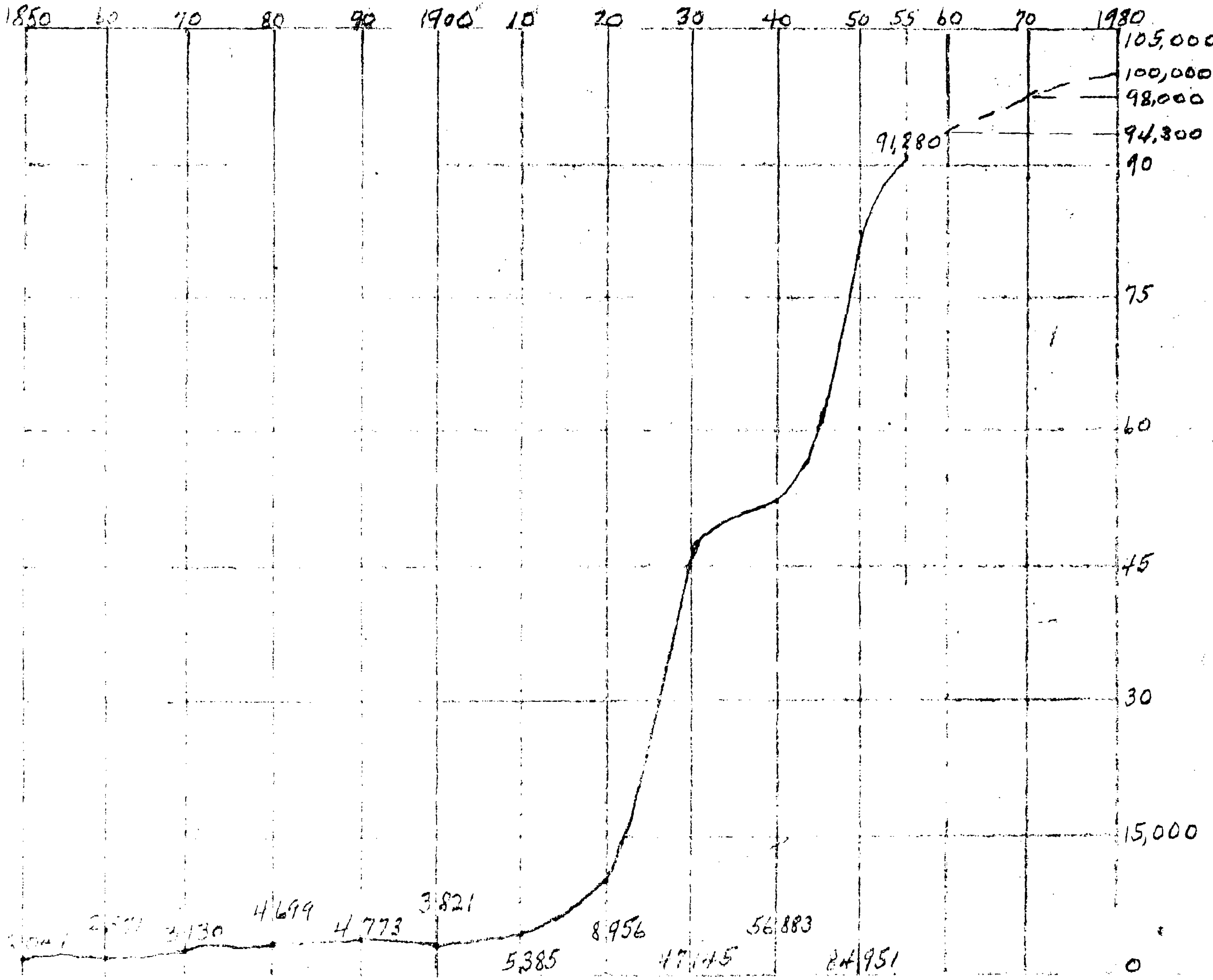

1900
20
30
40
50
55
60
70
1980
7,000
6
5
4
3
2,850
2,600
2,200
2
1,000
0
2,080
1648
2001
1,367
1,716



Upland Boro. — Density — 1955 Est. — 5,040/□mi. — 12.60/A



1850
60
70
80
90
1900
10
20
30
40
50
55
60
70
1980
21,000
18,000
15
12
9,050
9
7740
6
3,000
0
531
555
534
523
564
601
671
1577
3743
5280
6997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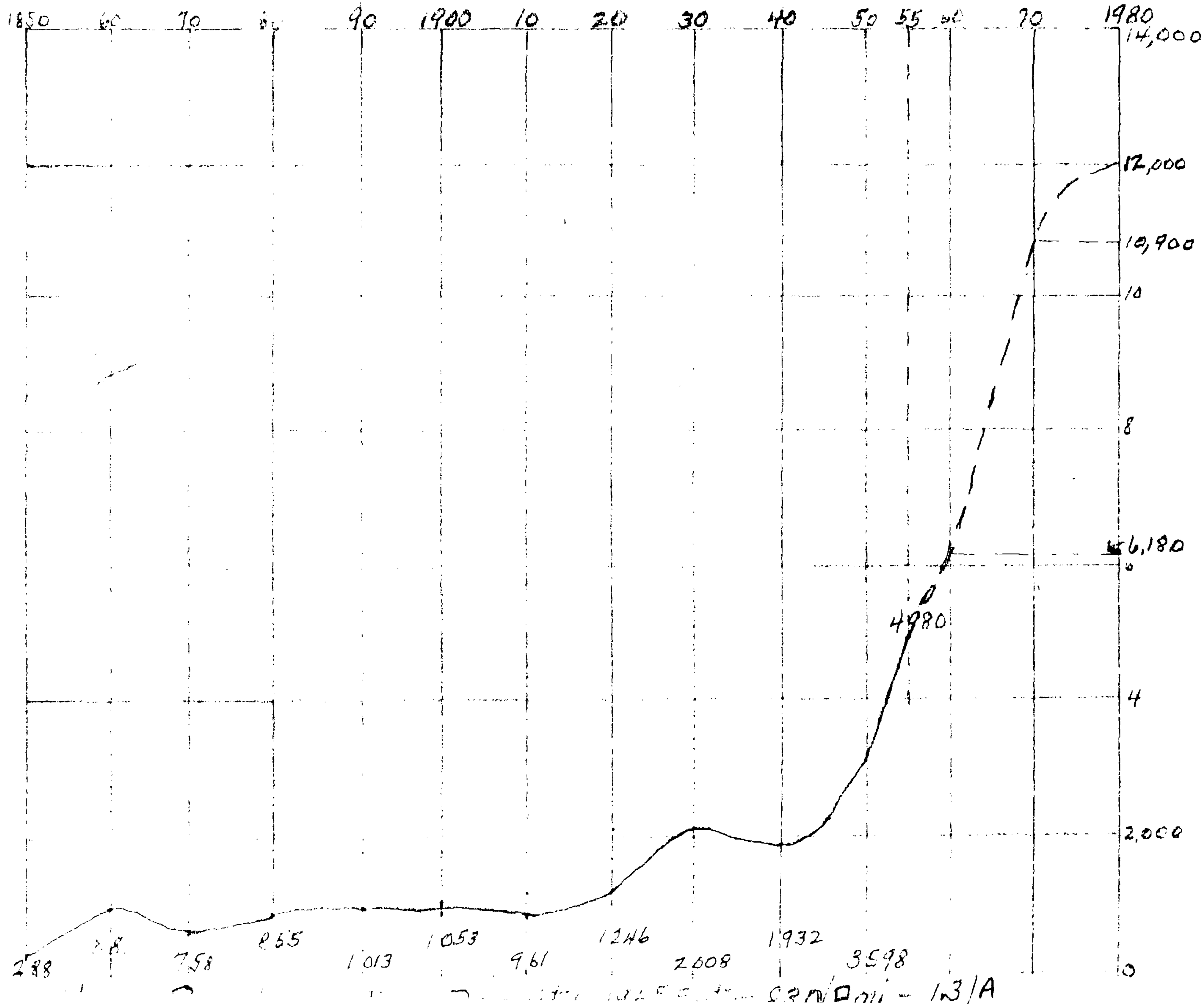
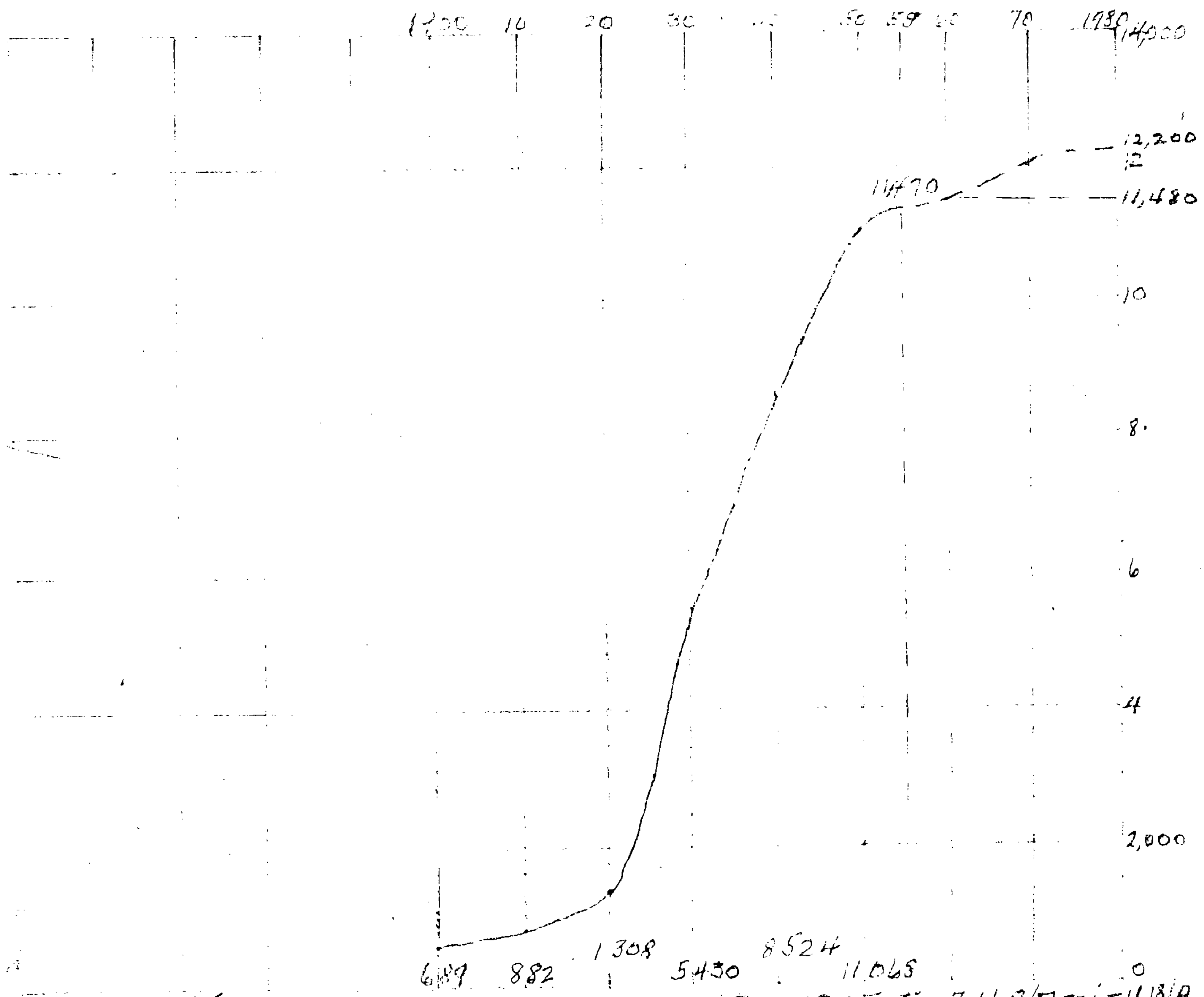
60
70
80
90
1900
10
20
30
40
50
55
60
70
1980
105,000
100,000
98,000
94,300
90
75
60
45
30
15,000
0
91,880
4,699
4,773
3,821
3,130
5,385
8,956
56,883
84,951


1850
60
70
90
1900
10
20
30
40
50
55
70
1980
14,000
12,000
10,900
10
8
6,180
4
2,000
0
4980
288
758
855
1013
1053
961
1246
2008
1932
3598
13/A


1900
10
20
30
50
59
60
70
1980
14,000
12,200
12
11470
11,480
10
8
6
4
2,000
0
689
882
1308
5430
8524
11,068

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION ALDAN BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

"Ed. Lafferty & Son - 108 Academy Ave. Glenolden, Pa. FA 9-0576"
Name Address Phone No.

Hauler - Rubbish

"Same"
Name Address Phone No.

Hauler - Ashes

"Same"
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage, Rubbish, Ashes " $225.00 per week

Point of Disposal Garbage "Outside of Boro"
Rubbish
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION ASTON TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(X)				( )
2. Rubbish	( )	( )	( )	(X)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (~~Municipal or~~ Private Contract)

Demko Brothers-Booths Corner, Boothwyn, Pa. Valleybrook 2525
Name Address Phone No.

Hauler - Rubbish

Louis Bruni - Box 366 Ellston Road, Chester, P.O.,Pa. Valleybrook 2769
Name Address Phone No.

Hauler - Ashes

Same as above
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $3,600.00 this year
Rubbish 9,000.00 this year
Ashes

Point of Disposal Garbage Out side of the township
Rubbish Out side of the township
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION BETHEL TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	( )				( )
2. Rubbish	( )	( )	( )	( )	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Name Address Phone No

"Bethel has no refuse collection."

Hauler - Rubbish

Name Address Phone No

Hauler - Ashes

Name Address Phone No

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage
Rubbish
Ashes

Point of Disposal Garbage
Rubbish
Ashes

TOWNSHIP OF BIRMINGHAM - DELAWARE COUNTY, PA.

MAILING ADDRESS • CHADDS FORD, PA.

MEETING NIGHT - 2ND TUESDAY

BOARD OF SUPERVISORS
EDWARD G. CRUM, *Chairman*
HENRY P. RUMFORD
WILLIAM P. GLEASON

LEWIS B. BEATTY, JR.
Township Solicitor

SARAH LEE BEARD
Secretary-Treasurer

February 15, 1956

Damon & Foster,
Mr. Carl H. Beck,
Chester Pike & High Street
Sharon Hill, Pa.

Dear Mr. Beck:

There is no organized system of collecting refuse in Birmingham Township. This township to-gether with Concord Township leases an old quarry into whichudry trash can be dumped. The dumping of paper or garbage is not permitted. The dump is open on Saturdays only at which time there is an attendant on duty.

Very truly yours,

Sarah Lee Beard, Secretary.

Sarah Lee Beard (Mrs A.J.)

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION BROOKHAVEN BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	( )				(✓)
2. Rubbish	( )	(✓)	( )	( )	(✓)
3. Ashes	( )				(✓)
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Marty DeFrank Garnet Mine Road, Boothwyn, Pa.
Name Address Phone No.

Hauler - Rubbish

Marty DeFrank Garnet Mine Road, Boothwyn, Pa.
Name Address Phone No.

Hauler - Ashes

Marty DeFrank Garnet Mine Road, Boothwyn, Pa.
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage Total contract for collection of garbage, rubbish
Rubbish and ashes is $7,000.00.
Ashes

Point of Disposal Garbage All hauled outside of Borough.
Rubbish
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION CITY OF CHESTER

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
1. Garbage	(x)	1:2:3	1:2	2:3	( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Nicholas Super   Westville Grove N.J.   Wildon 5-02[illegible]
Name   Address   Phone No.

Hauler - Rubbish & Ashes

Cameron Donato   Wilmont Park Wilmont Pa   Madison 8-[illegible]
Name   Address   Phone No.

Hauler - Ashes

Name   Address   Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage # 37,250
Rubbish ~~$ 102~~,333
Ashes

Point of Disposal Garbage Westville Grove N.J. - Piggery
Rubbish Ridley Twp. dump
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION CHESTER TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(X)				( )
2. Rubbish	( ) X	( )	( )	( )	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

WM. DEMKO PARKSIDE, CHESTER PA.
Name Address Phone No.

Hauler - Rubbish

MAURY DE FRANK BOOTHWYN, PA.
Name Address Phone No.

Hauler - Ashes

SAME AS RUBBISH
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage 2800 per year for 2 years
Rubbish / Ashes 6950 " " for one year

Point of Disposal Garbage Pigs on Demko's farm.
Rubbish / Ashes Donato's Dump - Eddystone

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION   CHESTER HEIGHTS BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	( )				( )
2. Rubbish	( )	( )	( )	( )	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Name   Address   Phone No.

"Chester Hts. Boro does not contract for refuse disposal. Each householder disposes of the refuse individually, as the cost to the Boro would be too expensive."
" Hilton E. Jones
Valleybrook Rd., Chester Hts., Pa.

Hauler - Rubbish

Name   Address   Phone No.

Hauler - Ashes

Name   Address   Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage ____
Rubbish ____
Ashes ____

Point of Disposal Garbage ____
Rubbish ____
Ashes ____

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION CLIFTON HEIGHTS BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(X)				( )
2. Rubbish	( )	(X)	( )	(X)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

WILLIAM DEMKO 117 CHELTOM RD. PARKSIDE, PA
Name Address Phone No.

Hauler - Rubbish

CHARLES MESSINA 7700 HOLSTEN ST - PHILA, PA - SA-9-596
Name Address Phone No.

Hauler - Ashes

CHARLES MESSINA 7700 HOLSTEN ST. - PHILA, PA - SA-9-5966
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $3500.00 YEAR
Rubbish $862.50 PER MONTH 10,350.00
Ashes

Point of Disposal Garbage
Rubbish 7700 HOLSTEN ST
Ashes 7700 HOLSTEN ST.

.51¢/Ton.

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

COLLINGDALE BORO

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(X)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Private contract Daniel Kinsley, Sewell, N.J.
Name Address Phone No.

Hauler - Rubbish

Norman Phillips 416 Lafayettee Ave. Collingdale.
Name Address Phone No.

Hauler - Ashes

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $3,640.00
Rubbish 10,650.00
Ashes

Point of Disposal Garbage unknown
Rubbish unknown
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

COLWYN BORO

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(X)				( )
2. Rubbish	( )	( )	( )	(X)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal ~~or Private~~ Contract)

Stanley Bandurski — Boothwyn Pa
Name — Address — Phone No.

Hauler - Rubbish

Thu. H. Kuliszewski — 338 Norris St Chester Pa — Chester 3-09
Name — Address — Phone No.

Hauler - Ashes

Name — Address — Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage 2 Years - Total $1958. 979.00
Rubbish 2 Years - Total 6000. 3,000.00
Ashes

Point of Disposal Garbage Not known
Rubbish Not known
Ashes

R. H. Yoagum

Concord Township has no collecting of either Garbage, Rubbish or Ashes.
There is a Township Dump in which residents may deposit unburnable Rubbish.

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

CONCORD TWP.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	( )				( )
2. Rubbish	( )	( )	( )	( )	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Name Address Phone No.

"Concord Twp. has no collecting of either Garbage, Rubbish or Ashes. There is a twp. Dump in which residents may deposit unburnable Rubbish."

Hauler - Rubbish

" C. Harkness"

Name Address Phone No.

Hauler - Ashes

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage
Rubbish
Ashes

Point of Disposal Garbage
Rubbish
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA. **DARBY BORO**

REFUSE COLLECTION

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

"William Ats Glen Mills Road Thornton, Pa."
Name Address Phone No.

Hauler - Rubbish

"John Leonard 211 Main St. Darby, Pa."
Name Address Phone No.

Hauler - Ashes

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $4,200.00 year
Rubbish $15,000.00 "
Ashes

Point of Disposal Garbage Unknown
Rubbish
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION DARBY TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(✓)				( )
2. Rubbish	( )	( )	( )	(✓)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

WILLIAM DEMKO — NAAMAN'S CREEK BOOTHWYN

Name — Address — Phone No.

Hauler - Rubbish

GEORGE PRATT — Oak Lane DARBY Township

Name — Address — Phone No.

Hauler - Ashes

Name — Address — Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $4560 - per annum
Rubbish } $16,500 - per annum
Ashes

Point of Disposal Garbage Demko farm
Rubbish } Township and private dumps
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION EAST LANSDOWNE BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Name	Address	Phone No.
William Demko	117 E. Chelten Rd., Parkside, Pa.	CHester 2-7327

Hauler - Rubbish

Name	Address	Phone No.
John W. Kuliszewski	338 Norris St., Chester, Pa.	CHester 3-0956

Hauler - Ashes

Name	Address	Phone No.
John W. Kuliszewski	338 Norris St., Chester, Pa.	CHester 3-0956

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $2388.00
Rubbish & Ashes $5000.00
Ashes

Point of Disposal Garbage
Rubbish
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION EDGMONT TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
1. Garbage	( )	1:2:3	1:2	2:3	( )
2. Rubbish	( )	( )	( )	( )	( )
3. Ashes	( )				
4.	( )				

Edgmont Twp. does not provide garbage rubbish or ash collection for residents. Each family takes care of their own disposal problem. there are 2 collectors I know of who haul the above away for which they charge between \$2 – \$3 per

Hauler - Garbage (Municipal or Private Contract)

Name Address Phone No.

Hauler - Rubbish

Name Address Phone No.

Hauler - Ashes

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage ______
Rubbish ______
Ashes ______

Point of Disposal Garbage ______
Rubbish ______
Ashes ______

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION FOLCROFT BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(x)				( )
2. Rubbish	(x)	( )	( )	( )	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Name	Address	Phone No.
Walter & Robt. Adams	7811 Chelwynde Ave	Phila. Penna.

Hauler - Rubbish

Name	Address	Phone No.
John Kuliszewski	338 Norris St.	Chester, Penna.

Hauler - Ashes

Name	Address	Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price:
Garbage $3,200.00 1 yr.
Rubbish 15,500.00 3 yrs.
Ashes

Point of Disposal
Garbage ??
Rubbish ??
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION GLENOLDEN BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(X)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

E. Lafferty & Son 737 W. Cook Ave. Glenolden P.O. Pa.
Name Address Phone No.

Hauler - Rubbish

John Kuliszewski 338 Norris Street Chester, Pa.
Name Address Phone No.

Hauler - Ashes

John Kuliszewski 338 Norris Street Chester, Pa.
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $5200.00 for year 1956
Rubbish } ~~$9000.00 for year 1956~~
Ashes }

Point of Disposal Garbage Unknown
Rubbish "
Ashes "

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION LANSDOWNE BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(X)				( )
2. Rubbish	(X)	( )	( )	(X)	(X)
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

STEPHEN BARRY, RD 4, WEST CHESTER, PA LENAPE 2321-R4

Name Address Phone No.

Hauler - Rubbish

HAKE & PRIVATE COLLECTORS MOST OF WHOM

Name LIVE IN AREA OF Address Phone No.
DARBY TOWNSHIP & SHARON HILL

Hauler - Ashes

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage 11,988 PER YR
Rubbish AVERAGE 15¢ PER CONTAINER
Ashes

Point of Disposal Garbage HOG FEEDING ON OWN FARM IN WEST CH
Rubbish PUBLIC DUMPS IN DARBY TOWNSHIP
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION MARCUS HOOK BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(X)				(X)
2. Rubbish	( )	( )	( )	(X)	(X)
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

TONY DeFRANK, Garnet Mine Road, Beethwyn, Penna.
Name Address Phone No.

Hauler - Rubbish

TONY DeFRANK, GARNET MINE ROAD, BOOTHWYN, PENNA.
Name Address Phone No.

Hauler - Ashes

TONY DeFRANK, GARNET MINE ROAD, BOOTHWYN, PENNA.
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				X
Rubbish				X
Ashes				X

Contract Price: Garbage $650 per year, (Two Year Contract)
Rubbish } ~~6,737.50 per year~~ " " "
Ashes }
Expires Feb. 15, 1957.

Point of Disposal Garbage Collector's Farm, Beethwyn, Penna.
Rubbish Quarry Hole - Millmont Park, Pa.
Ashes " " " " "

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION MIDDLETOWN TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(X)				(x)
2. Rubbish	(x)	( )	(x)	( )	(X)
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Various private collectors

Name Address Phone No.

Hauler - Rubbish

Various private Collectors

Name Address Phone No.

Hauler - Ashes

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage	Not applicable			
Rubbish				
Ashes				

Contract Price: Garbage Not applicable
Rubbish
Ashes

Point of Disposal Garbage Various piggeries
Rubbish Public Dumps
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION MILLBOURNE BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(X)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Name	Address	Phone No.
E. Mathews	309 N. Horton St.	Phila, Pa.

Hauler - Rubbish

Name	Address	Phone No.
Same		

Hauler - Ashes

Name	Address	Phone No.
Same		

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage) 975.00
Rubbish) $325.00 Month 2925.00
Ashes)

Point of Disposal Garbage New Jersey
Rubbish) Southwest Phila. Dumps
Ashes)

164/Mil

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION NETHER PROVIDENCE TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	( )				(X)
2. Rubbish	( )	(X)	( )	( )	(X)
3. Ashes	( )				(X)
4.	( )				

Hauler - Garbage (Municipal or Private Contract) Private Contractor's Contact

Name	Address	Phone No.
Morris Dorsey	807 Forrest St. South Media, Pa.	ME 6-4287

Hauler - Rubbish

Name	Address	Phone No.
Same	Same	

Hauler - Ashes

Name	Address	Phone No.
Same	Same	

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage ______
Rubbish ______
Ashes ______

Point of Disposal Garbage Private Dump - Bullens Lane
Rubbish " "
Ashes " "

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION NORWOOD BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(X)				( )
2. Rubbish	(X)	( )	( )	( )	( )
3. Ashes	(X)				( )
4.	( )				

Hauler - Garbage (~~Municipal~~ or Private Contract)

MARTIN LAND — BOOTHWYN, PA.

Name — Address — Phone No.

Hauler - Rubbish

BOROUGH OF NORWOOD

Name — Address — Phone No.

Hauler - Ashes

BOROUGH OF NORWOOD

Name — Address — Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price:
Garbage 3,060
Rubbish Approximately 6,000 per year for all expenses
Ashes

Point of Disposal
Garbage Mr. Lands Pigs near Boothwyn
Rubbish Borough Dump or Sanitary Landfill
Ashes Along Darby Creek

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION

PARKSIDE BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(X)				( )
2. Rubbish	( )	( )	( )	(X)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Marty DeFrank. Boothwyn. Pa.

Name Address Phone No.

Hauler - Rubbish & Ashes

Same

Name Address Phone No.

~~Hauler - Ashes~~

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage, Rubbish, Ashes — 1956 – $4830.00

Point of Disposal Garbage, Rubbish, Ashes — up to Collector

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION PROSPECT PARK BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Charles Schumm & Christian Walter, Media , R.D.2, Pa. ME 6-3286
Name Address Phone No.

Hauler - Rubbish

Cameron Donato, Milmont Ave., Milmont Park, Pa. WA 8 - 2131
Name Address Phone No.

Hauler - Ashes

SAME AS HAULER OF RUBBISH
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $3400.00 per year
Rubbish $7488.00 per year (ashes included)
Ashes

Point of Disposal Garbage Mt. Alverno Rd., R. D. 2, Media, Pa.
Rubbish Leiperville Quarry, Leiperville, Pa.
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA. RADNOR TWP.

REFUSE COLLECTION

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(X)				( )
2. Rubbish	(X)	( )	( )	(X)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Name	Address	Phone No.
Radnor Township	Wayne, Pa.	0500

Hauler - Rubbish

Name	Address	Phone No.
Radnor Township	Wayne, Pa.	0500

Hauler - Ashes

Name	Address	Phone No.
Radnor Township	Wayne Pa.	0500

~~When Contract is based on Tons, state~~ Estimated tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage	21			
Rubbish	~~25~~ including ashes			
Ashes				

Contract Price: Garbage $5,000.00 per year dumping privilege.
Rubbish $2,400 per year dumping privilege
Ashes including ashes.

Point of Disposal Garbage Morristown, Pa.
Rubbish Sharon Hill, Del. Co. Pa.
Ashes Sharon Hill, Del. Penna.

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION RIDLEY TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Martin Land & Sons R.F.D. #1 Bethel Road, Boothwyn Ch: 5-0423
Name Address Phone No.

Hauler - Rubbish

Cameron Donato Milmont Avenue, Milmont Park Wa: 8-2131
Name Address Phone No.

Heuler - Ashes

Same as Rubbish
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $12,000.00 Year
Rubbish $39,626.00 Year for Rubbish and Ashes
Ashes

Point of Disposal Garbage Land Farm - Boothwyn
Rubbish Bullens Lane - Woodlyn
Ashes " "

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION RIDLEY PARK BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	( )				( )
2. Rubbish	( )	( )	( )	( )	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal ~~or Private~~ Contract)

Raymond J. McCann 1010 Concord Avenue, Chester, Pa. Chester 4-4507
Name Address Phone No.

Hauler - Rubbish

John W. Kuliszewski 338 Norris Street Chester, Pa. Chester 3-0956
Name Address Phone No.

Hauler - Ashes

Same as for rubbish
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage	Contracts			
Rubbish	not			
Ashes	based on	tonnage		

Contract Price: Garbage $ 4,490.00 per year
Rubbish $ 8,000.00 per year
Ashes

Point of Disposal Garbage Piggery
Rubbish Philadelphia
Ashes "

February 17, 1956

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION ROSE VALLEY BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	( )				( )
2. Rubbish	( )	( )	( )	( )	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

" Sylvester Seeney 8 Morton Ave., Morton, Pa. SW 6-2825 "
Name Address Phone No.

" Morris Dorsey, Jr. 807 Forrest Ave.Moylan, Pa. ME 6-4287 "

Hauler - Rubbish

" Samuel W. Batipps 708 Washington Ave.Moylan.Pa. ME 6-3059 "
Name Address Phone No.

"All rubbish, ashes and garbage from the Boro of Rose Valley are removed by private contract. Those having permits to haul in theBoro of Rose Valley are named here."

Hauler - Ashes

" Birl C. Clark 441 Washington Ave.,Media,Pa. ME 6-1444 "
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage ________
Rubbish ________
Ashes ________

Point of Disposal Garbage ________
Rubbish ________
Ashes ________

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION RUTLEDGE BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(X)				( )
2. Rubbish	( )	( )	( )	(X)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract) Municipal Contract

Stanley Bandurski P.O.Box, Boothwyn, Penna. Unknown
Name Address Phone No.

Hauler - Rubbish

Walter L.Ball 1825 Hook Road, Folcroft, Pa. Faragut 6-8944
Name Address Phone No.

Hauler - Ashes

Same as Rubbish
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $125.00 per month
Rubbish $175.00 per month
Ashes

Point of Disposal Garbage Bandurski's Pig ery, Boothwyn, Pa.
Rubbish Unknown
Ashes

Betty W. Collison, Secretary
(Mrs. Frederick G. Collison)

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION SHARON HILL BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(✓)				( )
2. Rubbish	( )	( )	( )	(✓)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (~~Municipal or~~ Private Contract)

Wm. J. Atz Thornton, Pa.

Name Address Phone No.

Hauler - Rubbish

Boro of Sharon Hill

Name Address Phone No.

Hauler - Ashes

Boro of Sharon Hill

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage 4200.00
Rubbish
Ashes

Point of Disposal Garbage Atz Farm
Rubbish } Salerno's Dump
Ashes }

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION SPRINGFIELD TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract) Municipal contractor

Edward E. Seder — Westville Grove, N. J. — Tilden 5 - 9616

Name — Address — Phone No.

Hauler - Rubbish

Township Employees collect exclusively

Name — Address — Phone No.

Hauler - Ashes

Same as rubbish

Name — Address — Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

		Day	Week	Month	Year
Garbage	Estimated	15 ton	6 days a week		
Rubbish	Estimated	109 Yards a day for 5 days - 26 yds Sat.			
Ashes	"				

Contract Price: Garbage — Contract $31,475 plus add'l for new construction
Comb. Rubbish — Budget est. 1956 $49,000.-
Ashes — included with rubbish

Point of Disposal Garbage — Piggery - Westville Grove, N. J.
Comb. Rubbish — Contract dump - Philadelphia, Pa.
Ashes — " " " "

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION SWARTHMORE BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(✓)				( )
2. Rubbish	( )	( )	( )	(✓)	(✓)
3. Ashes	( )				(✓)
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Stanley Bandarski, Upper Marsh Road, Boothwyn Pa. Holly Oak 3516
Name Address Phone No.

Hauler - Rubbish
Wm Brooks Morton, Pa. SW-6 1448
Sylvester Seeney " " SW-6-[illegible]
Warren Pierce, Swarthmore, Pa. SW-6-2079
L.W. Grobes, 1300 Remington St., Chester CH-2-4230
Name Address Phone No.

Hauler - Ashes
Same
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage	About 8 Tons per Week			
Rubbish				
Ashes				

Contract Price: Garbage $8000.00 per year from back door, 2 times per we[illegible]
Rubbish
Ashes

Point of Disposal Garbage Hog Farm at Boothwyn, Pa.
Rubbish Unknown
Ashes "

Borough of Swarthmore

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION   THORNBURY TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	( )				( )
2. Rubbish	( )	( )	( )	( )	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Name   Address   Phone No.

"We have no collections of any kind in Thornbury Twp. Disposal is all individually done."

Hauler - Rubbish   "Cornelia C. Laws; Sec.
Board of Supervisors."

Name   Address   Phone No.

Hauler - Ashes

Name   Address   Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage ____________
Rubbish ____________
Ashes ____________

Point of Disposal Garbage ____________
Rubbish ____________
Ashes ____________

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION TINICUM TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Frank Darczuk Zebley Road, Boothwyn, Pa.
Name Address Phone No.

Hauler - Rubbish

Township of Tinicum, Essington, Pa. TI3-8444
Name Address Phone No.

Hauler - Ashes

Township of Tinicum, Essington, Pa.
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $2,400.
Rubbish
Ashes

Point of Disposal Garbage
Rubbish Township dump
Ashes Township dump

Township of Tinicum
Mrs. Ruth Zuzak, Secretary

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

THE BOROUGH OF TRAINER

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION TRAINER BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(xX)				( )
2. Rubbish	(X)	( )	( )	( )	( )
3. Ashes	(X)				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

STANLEY BANDURSKI BETHEL & MARSH ROADS BOOTHWYN PA
Name Address Phone No.

Hauler - Rubbish

THE BOROUBH OF TRAINER
Name Address Phone No.

Hauler - Ashes

THE BOROUGH OF TRAINER
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

Contract Price: Garbage $960 annually
Rubbish
Ashes

Point of Disposal Garbage OUTSIDE OF BOROUGH
Rubbish INSIDE " "
Ashes " " "

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION UPLAND BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Walter & Robert Adams, 7811 Chelwynde Ave., Phila Pa Belgrade 6-2639

Name Address Phone No.

Hauler - Rubbish

George Pratt--8544 Lindbergh Blvd., Phila Pa. Belgrade 6-2357

Name Address Phone No.

Hauler - Ashes Same as above

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage		8		
Rubbish				
Ashes				750

Contract Price: Garbage $1,000.00
Rubbish }
Ashes } [illegible].00

Point of Disposal Garbage Booths Corner
Rubbish
Ashes Sharon Hilla Pa

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION   UPPER CHICHESTER TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together 1:2:3	1:2	2:3	Household Contract
1. Garbage	(x)				( )
2. Rubbish	( )	( )	( )	(x)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Wm. Demkc   Prvt. Contract   Chester, Pa.
Name   Address   Phone No.

Hauler - Rubbish

Upper Chichester Township   own labor and truck   Ch. 5-1296
Name   Address   Phone No.

Hauler - Ashes

Upper Chichester Township   own labor and truck   5-1296
Name   Address   Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				x
Rubbish	x			
Ashes	x			

Contract Price: Garbage for 1956 $ 3,360.00
Rubbish estimated for 1956 $ 9,000.00
Ashes

Point of Disposal Garbage Contractor has his own
Rubbish
Ashes wherever the township can obtain a dump.

AS OF FEBRUARY 1954
POPULATION 88,000

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION UPPER DARBY TWP.

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(x)				( )
2. Rubbish	(x)	( )	( )	( )	( )
3. Ashes	NONE	AMOUNT SMALL, COLLECTED BY TWP.			( )
4. RUBBISH	(x)	PRIVATE COLLECTORS			

Hauler - Garbage (Municipal or Private Contract)

Name Address Phone No.

Hauler - Rubbish

UPPER DARBY TWP. — TOWNSHIP BUILDING UPPER DARBY — FANDERS 2-4100

Name Address Phone No.

Hauler - Ashes

UPPER DARBY TWP. — TOWNSHIP BUILDING UPPER DARBY — FANDERS 2-4100

Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage	30.5			
Rubbish	109.9			
Ashes				
RUBBISH ~~PRIVATE COLLECTORS~~	~~45.6~~			

Contract Price: Garbage 60,000
Rubbish 250,000
Ashes

Point of Disposal Garbage NEW JERSEY
Rubbish PHILA. PA. 64TH & INDUSTRIAL HIGHWAY
Ashes

DAMON & FOSTER
Registered Civil Engineers & Surveyors
Chester Pike & High Street
Sharon Hill, Pa.

DELAWARE COUNTY, PENNA.

REFUSE COLLECTION YEADON BORO

Kindly insert a check (x) in the appropriate bracket

	Collected Separately	Collected Together			Household Contract
		1:2:3	1:2	2:3	
1. Garbage	(X)				( )
2. Rubbish	( )	( )	( )	(X)	( )
3. Ashes	( )				( )
4.	( )				

Hauler - Garbage (Municipal or Private Contract)

Jane Blosienski, R.D. No. 1, Downingtown Downingtown-987-R-1
Name Address Phone No.

Hauler - Rubbish

Charles Messina, 7700 Holstein Ave. Phila. SA-9-5968
Name Address Phone No.

Hauler - Ashes

Same as rubbish
Name Address Phone No.

When Contract is based on Tons, state tonnage per day, week, month or year in Summer

	Day	Week	Month	Year
Garbage				
Rubbish				
Ashes				

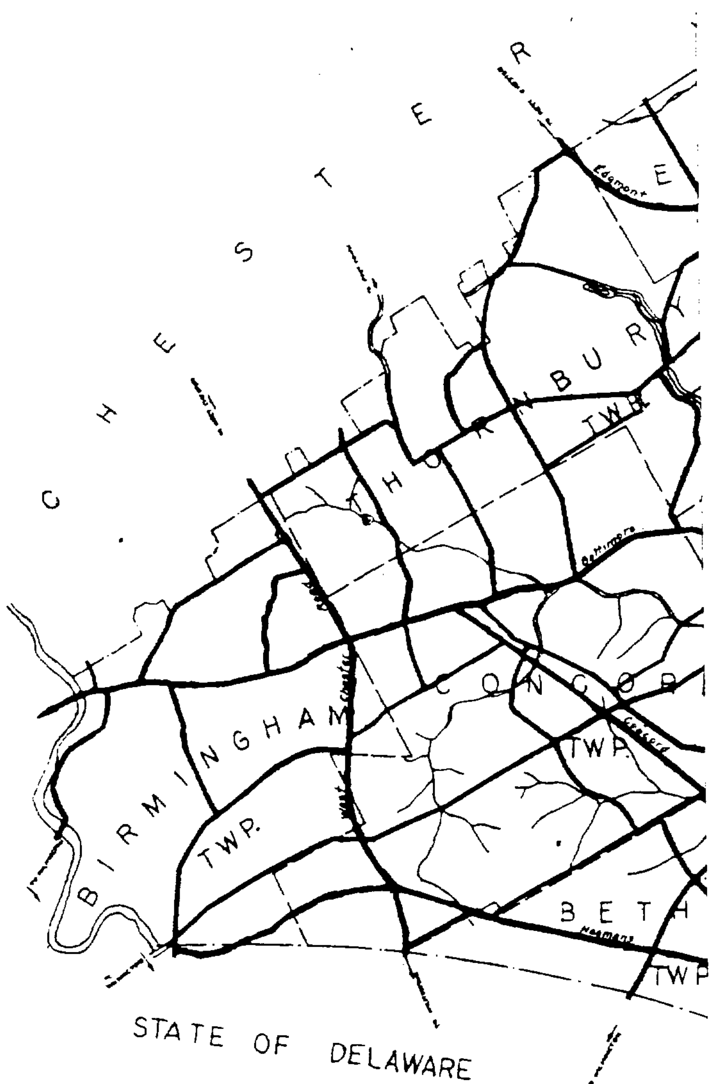
Contract Price: Garbage $9,408.00 for year of 1956
Rubbish } Ashes } $16,672.00 for year of 1956

Point of Disposal Garbage On her farm near Downingtown
Rubbish } Ashes } On his property at above address

DELAWARE COUNTY INCINERAT(
DELAWARE COUNTY, PE

DAMON & FOSTER
CONSULTING ENGINEERS
SHARON HILL, PA.
COTTON, PIERCE, STREANDER,
ASSOCIATE ENGINEERS
NEW YORK CITY, N.Y.
MARCH 1956

Note
Highways & Roads



APPENDIX 3

DELAWARE COUNTY, PENNA.	Road Miles			
	Plan A App. III-C	Plan B App. III-D	Plan C App. III-E	Plan D App. III-F
Aldan Boro	1.80	2.70	2.70	2.70
Aston Twp.	2.04	1.35	2.47	2.02
Bethel Twp.	5.96	5.40	7.42	6.07
Birmingham Twp.	7.50	8.50	3.82	2.49
Brookhaven Boro	3.95	2.13	2.13	1.12
Chester City	5.40	3.24	2.47	1.91
Chester Twp.	4.16	3.24	2.47	1.80
Chester Heights Boro	2.25	3.15	2.92	6.07
Clifton Heights Boro	.67	3.37	3.37	3.37
Collingdale Boro	2.25	2.47	2.47	2.47
Colwyn Boro	3.82	3.60	3.60	3.60
Concord Twp.	5.17	6.75	3.15	1.35
Darby Boro	3.15	3.15	3.15	3.15
Darby Twp.	3.20	2.70	2.70	2.70
East Lansdowne Boro	3.48	6.07	6.07	6.07
Eddystone Boro	8.10	4.50	4.50	4.50
Edgmont Twp.	4.61	3.48	3.48	.75
Folcroft Boro	3.71	2.70	2.70	2.70
Glenolden Boro	3.93	.78	.78	.78
Haverford Twp.	3.95	2.25	2.25	2.25
Lansdowne Boro	2.70	4.16	4.16	4.16
Lower Chichester Twp.	4.95	5.85	5.06	4.95
Marcus Hook Boro	5.51	6.30	5.06	4.83
Marple Twp.	5.85	2.25	2.25	2.25
Media Boro	4.27	3.30	4.27	5.40
Middletown Twp.	2.58	3.15	4.05	4.95
Millbourne Boro	3.60	4.22	4.22	4.22
Morton Boro	3.15	2.47	2.47	2.47
Nether Providence Twp.	5.62	4.27	3.15	3.15
Newtown Twp.	6.25	4.15	4.15	4.15
Norwood Boro	4.38	1.23	1.23	1.23
Parkside Boro	5.28	3.37	1.57	2.13
Prospect Park Boro	5.40	2.02	2.02	2.02
Radnor Twp.	7.10	5.85	5.85	5.85
Ridley Twp.	4.95	1.80	1.80	1.80
Ridley Park Boro	6.30	2.02	2.02	2.02
Rose Valley Boro	4.61	2.25	2.70	3.37
Rutledge Boro	4.50	2.25	2.25	2.25
Sharon Hill Boro	3.26	2.47	2.47	2.47
Springfield Twp.	3.15	3.60	3.60	3.60
Swarthmore Boro	4.95	3.93	3.93	3.93
Thornbury Twp.	7.20	7.87	2.70	4.16
Tinicum Twp.	6.75	3.26	3.26	3.26
Trainer Boro	4.20	5.28	4.05	3.93
Upland Boro	4.95	2.70	1.57	.67
Upper Chichester Twp.	4.50	3.82	4.50	4.72
Upper Darby Twp.	2.25	3.15	3.15	3.15
Upper Providence Twp.	4.38	4.61	4.95	4.50
Yeadon Boro	3.93	4.50	4.50	4.50

DELAWARE COUNTY, PENNA. APPENDIX 3 - c

	Ton Miles per Day - 1955			
	Plan A App.III-C	Plan B App.III-D	Plan C App.III-E	Plan D App.III-F
Aldan Boro	11.90	17.80	17.80	17.80
Aston Twp.	22.00	14.20	26.65	21.80
Bethel Twp.	16.18	14.72	20.20	16.50
Birmingham Twp.	11.10	12.50	5.62	3.63
Brookhaven Boro	19.32	10.62	10.62	5.43
Chester City	605.00	364.00	278.00	126.00
Chester Twp.	27.12	21.15	16.20	11.74
Chester Heights Boro	1.76	2.46	2.46	.87
Clifton Heights Boro	8.55	43.30	43.30	43.30
Collingdale Boro	36.00	39.65	39.65	39.65
Colwyn Boro	13.46	12.70	12.70	12.70
Concord Twp.	19.10	24.80	11.60	4.97
Darby Boro	71.20	71.20	71.20	71.20
Darby Twp.	51.10	43.20	43.20	43.20
East Lansdowne Boro	20.16	35.00	35.00	35.00
Eddystone Boro	41.80	23.20	23.20	23.20
Edgmont Twp.	9.45	7.14	7.14	1.54
Folcroft Boro	26.30	19.20	19.20	19.20
Glenolden Boro	46.60	9.26	9.26	9.26
Haverford Twp.	312.00	178.00	178.00	178.00
Lansdowne Boro	62.00	95.4	95.4	95.4
Lower Chichester Twp.	26.50	31.38	27.10	26.50
Marcus Hook Boro	34.00	39.00	31.30	29.70
Marple Twp.	104.40	40.20	40.20	40.20
Media Boro	42.50	33.00	33.00	33.00
Middletown Twp.	29.10	36.00	46.20	15.85
Millbourne Boro	5.18	6.07	6.07	6.07
Morton Boro	9.05	7.12	7.12	7.12
Nether Providence Twp.	74.00	56.20	41.30	41.30
Newtown Twp.	62.80	41.70	41.70	41.70
Norwood Boro	39.60	11.10	11.10	11.10
Parkside Boro	17.50	11.20	5.20	7.07
Prospect Park Boro	56.00	20.80	20.80	20.80
Radnor Twp.	208.00	172.00	172.00	172.00
Ridley Twp.	212.00	77.00	77.00	77.00
Ridley Park Boro	66.40	13.40	13.40	13.40
Rose Valley Boro	3.60	1.93	2.32	2.77
Rutledge Boro	5.83	3.42	3.42	3.42
Sharon Hill Boro	32.90	25.00	25.00	25.00
Springfield Twp.	109.20	124.60	124.60	124.60
Swarthmore Boro	45.80	36.60	36.60	36.60
Thornbury Twp.	27.26	29.90	10.27	15.72
Tinicum Twp.	62.64	30.20	30.20	30.20
Trainer Boro	14.00	17.60	13.60	13.10
Upland Boro	38.20	20.82	12.13	5.17
Upper Chichester Twp.	55.70	47.60	55.70	58.40
Upper Darby Twp.	330.00	460.00	460.00	460.00
Upper Providence Twp.	35.00	36.70	39.40	35.70
Yeadon Boro	72.00	82.50	82.50	82.50
T.mi./da.	3,251.56	2,572.54	2,435.63	2,216.38
T.mi./yr.(300da)	975,468.00	771,762.00	730,689.00	664,914.00